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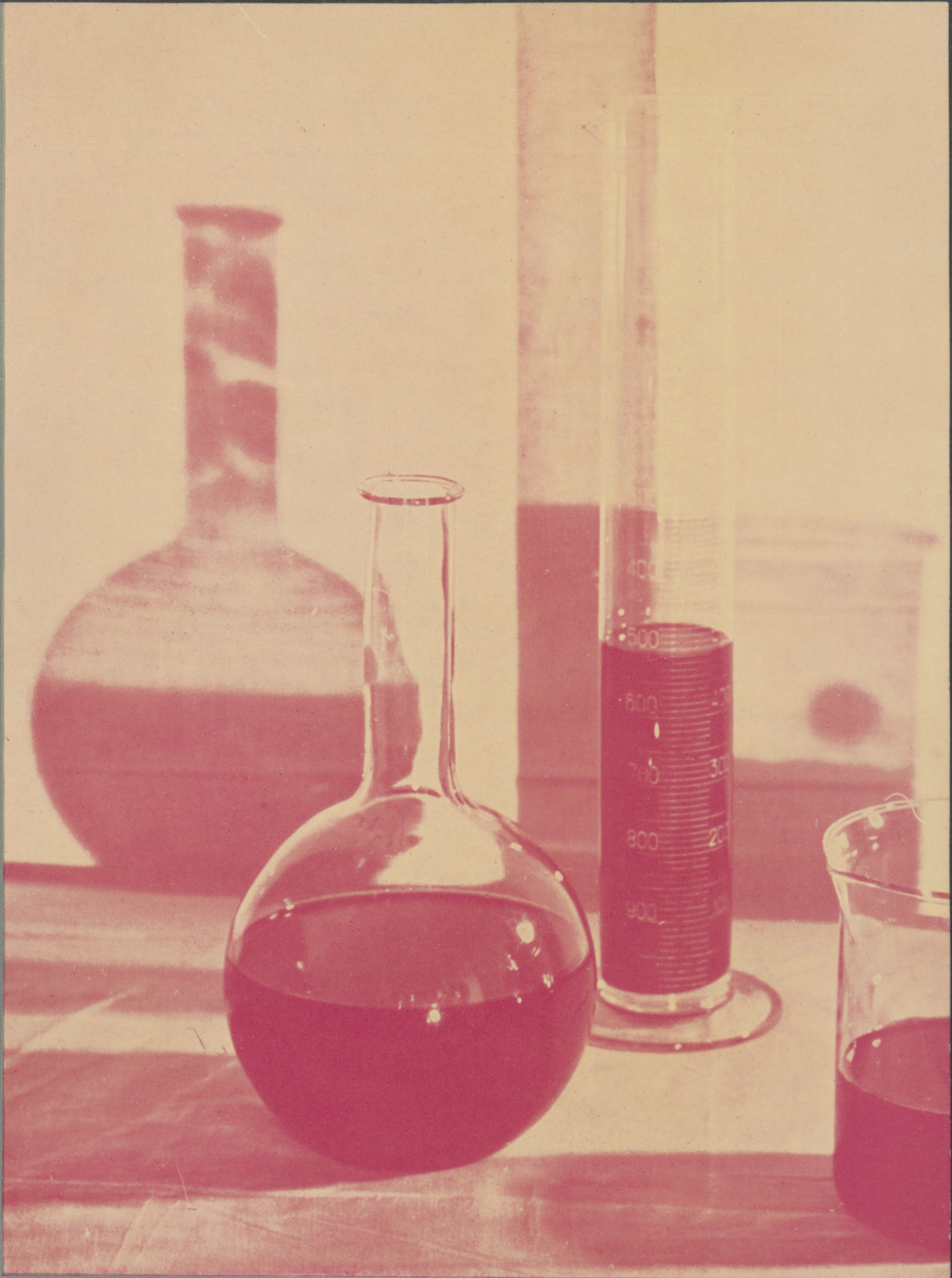

Design For D.T.'S

Airpockets

Beryllium Alloys

ROSE TECHNIC

J. Edward Taylor, *Editor*
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ROSE TECHNIC

APRIL 1940

VOLUME XLIX NUMBER 7

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ROSE POLYTECHNIC INSTITUTE
LABOR ET SCIENTIA
1874

DESIGN FOR D.T.'S

by Willis R. Lucas, c., '40

Earthquake-resistant design has progressed in definite periods, each receiving its impetus from a catastrophic earthquake. Earthquake shock at the site of the structure is produced by an elastic wave that originates probably deep in the earth from an earth slip. Many elastic waves may start simultaneously from different places along the earth slip and because of interference between waves and filtering action by earth formations the arriving wave has a form of variance. Generally, these elastic waves are considered as simple harmonic in shape. Earthquake-resistant design emphasizes building for withstanding the acceleration forces that are imposed on the structure by the elastic wave.

To quell potential smile innuendoes relating to our good civil engineering brethren, "Design for D.T.'s" (Design for Diabolical Tremors) brings to the reader some unusually interesting facts about epicenters, siesmographs, and things in a very readable form.

STRUCTURAL-DESIGN progress in the field of earthquake-resistant construction has been divided into successive periods, each usually initiated by a major quake which greatly increased incentive to research. The major progress may well be divided into four periods: (1) 1880 to 1906 (the date of the San Francisco earthquake); (2) 1906 to 1923 or 1925 (the dates, respectively, of the Tokyo and Santa Barbara earthquakes); (3) 1925 to 1933 (the year of the Long Beach earthquakes); and (4) 1933 to the present time. It is only by reviewing the comparatively short history of seismology and seismic design of these periods that progress in this field can be appreciated.

Certain names are connected with the studies of earthquakes, the first being John Milne, the great English scientist, who was invited to Japan to teach mining and geology in 1875. In 1880 he formed the Seismological Society of Japan and for 15 years thereafter he contributed much to our knowledge of earthquakes and their effect on structures. Other eminent seismologists of those early days were Seikei Sekiya and Fusechi Omori.

Some of the important conclusions of these early Japanese investigators were generally accepted by American engineers until about 1928, when results from more precise instruments and more extensive study began to cast doubt on their validity. These conclusions, however, are worth recording as representing the first step in the study of earthquake-resistant design. They may be summarized as follows:

1. Structures should be made homogeneous as far as possible, with all parts firmly tied together.

2. An earthquake wave may be assumed, for purposes of study, to have a simple harmonic motion.

3. The destructive force of an earthquake may be measured by its acceleration, and the maximum acceleration of an earthquake may be estimated from the forces required to overturn stone lanterns and other objects.

4. The acceleration and amplitude of an earthquake and the damage done by an earthquake are much greater in alluvial soil than on firm ground.

5. The acceleration and amplitude of an earthquake are much greater at the surface of the ground than at an appreciable distance below the surface.

6. Short columns or piers having periods not greater than that of the earthquake suffer the greatest damage near the base, while tall structures, such as tall chimneys, behave as though the earthquake force acted impulsively at a center of percussion. Omori stated that his observations showed that tall, free-standing chimneys generally broke, not near their base, but at two-thirds of their height.

7. The period of a destructive earthquake varies from one-half to one and one-half seconds.

8. The direction of maximum horizontal motion of an earthquake is normal to the line joining the station of observation with the epicenter of the earthquake, and the greatest movement is due to transverse vibrations.

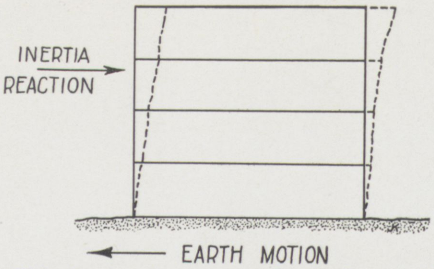
San Francisco Quake

California and Japan have been fertile fields for observation and development. In California the interest of engineers in earthquake-resistant design may be said to have begun with the great San Francisco earthquake of 1906. A committee of the San Francisco Association of Members of the American Society of Civil Engineering made an extensive study of this earthquake and its effects. For many years their conclusions were used in the structural design of building. It is to be remembered that in 1906 reinforced concrete was in its infancy, and its use in construction was not permitted in San Francisco and surrounding cities. The developments after the San Francisco Quake were as follows:

1. Sufficient evidence is at hand to warrant the statement that a building designed with a proper system of bracing to withstand wind and a pressure of 30 lb. per sq. ft. will resist safely the stresses caused by shock of an intensity equal to that of the recent earthquake.

2. The prime requisite of the structure is elasticity. To this requirement the building with a timber or steel frame answers very well. The reinforced concrete structure does also with exceptions. The building of stone, brick, or block construction, having mortar joints, does not answer the requirement at all.

"Moonlight" theme taken at four o'clock (in the afternoon by sworn statement) with the Speed-Graphic camera newly acquired by the TECHNIC. Filters were used to obtain night effect. The setting is the whispering pines, high on the hill-top overlooking Lake Deming on the campus.



With the foundation on rock, the bottom of the building must move with the earth, having the same acceleration and velocity as the ground. Motion of the more-or-less elastic superstructure lags from bottom to top, usually around a second.

3. Foundations did not suffer at all . . . The evidence is that foundations well built along accepted lines are adequate.

4. It may be questioned whether difference in workmanship was not responsible for many of the results. While it is true that good workmanship gives better results than ordinary, it is still the opinion of the writer that it was mainly a question of design.

5. A brick spandrel wall adds little if any to the bracing of a steel frame.

6. All evidence in the recent shock favors reinforced concrete, but the writers are of the opinion that the steel frame offers the best solution of the problem.

7. Some discussion has taken place as to the advisability of making a monolithic mass under the building. Several of these have been constructed . . . They are all of relatively small base. Buildings of 12 stories and a base of 150 feet with isolated pier foundations suffered no more than similar buildings with monolithic bases.

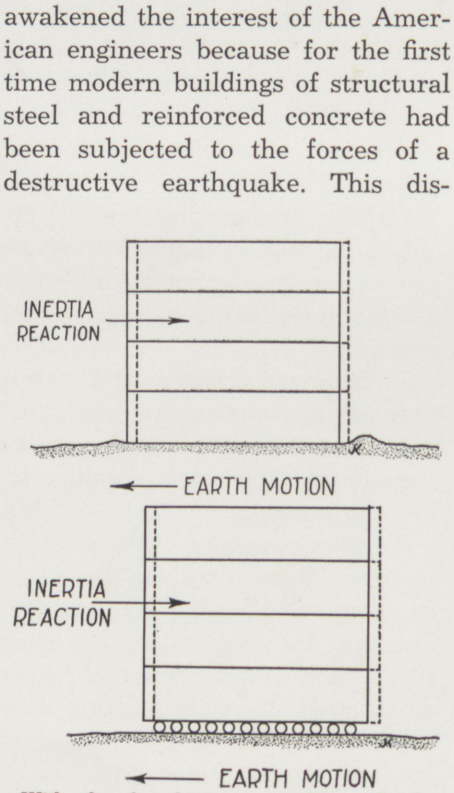
8. The writers reiterate the statement that, speaking generally, buildings of brick walls and wooden interiors cannot be built which will not be wrecked in a severe shock, it being a fault of design and not of materials or workmanship.

The first conclusion relating to the effect of the wind force is erroneous, but the remainder of the conclusions are still regarded as essentially sound.

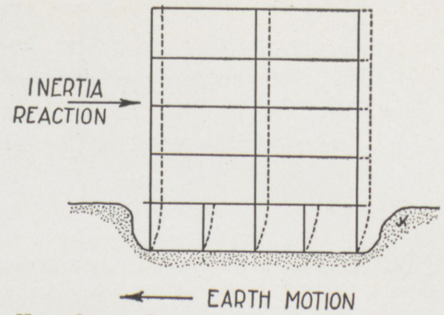
Progress, after the San Francisco earthquake, was again at a standstill and was revived only by the Tokyo disaster of 1923. Engineers considered buildings had proper earthquake resistance if they had strong, structural-steel frames with wind girders, gusset-plate connections in the wall spandrels, and somewhat heavier than standard connections in the interior; provided the masonry, brick, or reinforced concrete walls were well anchored to the structural frame. The most important change was that members and connections were designed with the thought that they would have to withstand earthquake shocks, although no mention of earthquake shocks were in the building ordinance. In the revision of the San Francisco building ordinance following the earthquake, the issue was evaded by high values of wind pressure, minimum sizes of structural members, and limitations on dimensions of wall. The fundamental principles embodied in this period are today considered to be among the essentials of seismic design.

Tokyo Quake Ushers in Third Period

The third period, ushered in by the Tokyo quake, immediately awakened the interest of the American engineers because for the first time modern buildings of structural steel and reinforced concrete had been subjected to the forces of a destructive earthquake. This disaster brought about the publication of the textbook "Earthquake-Proof Construction" by Dr. Tachu Naito.



With the foundation on soft or slippery ground, the imperfect transfer of motion from the ground to the structure may greatly lessen the stresses in the superstructure. The motion would be as though the entire structure rested on roller bearings.

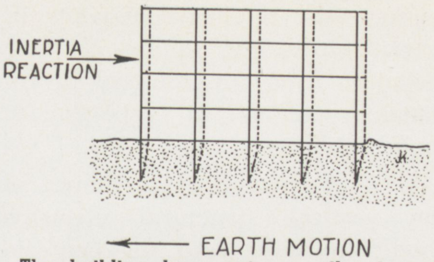


Here the rigid superstructure rests on steel columns. The elasticity of the columns cushions the impact on the rigid structure, but the force is fully transmitted, and the movement of the superstructure will probably be increased.

Naito's work has had a profound influence on structural design in California and elsewhere. He was the first to make practical use of the principle that horizontal force on a building with stiff floors is distributed among the structural elements of the building in proportion to their relative rigidities and not in proportion to wall areas or column spacing. He set forth practical methods for determining the rigidity of walls, partitions, and structural frames. He showed that shearing deformations in walls were more important than flexural deformations and realized the importance of a symmetrical arrangement of resisting units. California engineers devised the principle that the centroid of the resisting units of a building must coincide with the centroid of mass of the building, if dangerous torsional moments due to earthquakes are to be avoided.

Flexibility vs. Rigidity

The trend of thought during this period followed two principle theories, flexibility and rigidity. One theory held that the essential factor was combining the principle of rigidity with strength. The other theory held that sufficient strength and rigidity were unnecessarily expensive and difficult to obtain, and that flexibility was not only essential but reduced the amount of strength necessary to resist earthquake shock. It is now generally accepted by a large majority of engineers who have carefully studied



The building here rests on piles in soft ground. The soft ground suffers a distortion in common with the piles, of an inch or two at the top, and relieves the stress and motion on the building.

earthquake effects that the greatest practicable structural rigidity is desirable, and the problem largely resolves itself into one of providing ample structural strength against destructive distortion from horizontal forces.

Those who have studied the problem carefully recognize that in lessening the amplitude of oscillation of a building due to the earth's movements, it is extremely important to make the oscillation period of the building smaller than the oscillation period of the ground ordinarily found in great earthquakes. Nevertheless, there are a few engineers of prominence who strongly favor flexibility in the design of lower story columns of tall buildings.

The commonly advocated type of flexibility proposes elastic steel columns fixed at both ends in the basement or first story. Therefore the top of the building may oscillate back and forth without exceeding the safe elastic limit of steel.

The supposed efficiency of the elastic first story columns has been disproved by the demonstrations of Professor R. R. Martel with the shaking-table model in the Engineering laboratory at Stanford. The shaking-table is used to test scale models of important buildings and for experimental purposes. By algebraic analysis, and computations of examples covering elastic deflection, Professor Martel concludes:

1. The flexible first story does not reduce accelerations of the upper portions of the building when the period of the earthquake is greater than the free period of the building. For such cases, the greater the flexibility, the greater will be the acceleration of the upper portion.

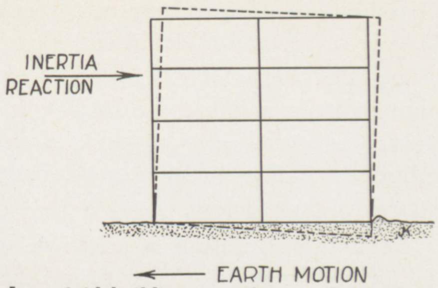
2. The limits of successful performance of the flexible first story are fixed, not only by the permissible deflection of the columns but by the acceleration transmitted to the upper portion of the building. For the most favorable cases which have been considered, cases which would be difficult to realize in practice, these limits are for earthquakes with periods of one second or less.

3. Even in this range, the possibility of harmonic resonance remains.

In 1929 the World Engineering Congress meet in Tokyo, and the major subject of discussion was the seismic design and construction of buildings. The American engineers found the Japanese theoretical and experimental work much in advance to theirs, so they accepted the Japanese conclusions. The majority of the Japanese engineers favored the rigid type of buildings. This was natural due to the height limit of 100 feet in Japan, which makes this type of construction entirely practicable. Rigid buildings, designed to withstand an acceleration of one-twentieth to one-tenth gravity with normal working stresses, survived the great 1923 quake without appreciable damage. Consequently the seismic factor of one-tenth was accepted for earthquake-resistant design.

The seismic factor, or measure of earthquake force to be resisted, is most commonly expresed as one-tenth the acceleration due to gravity. This says the structure should be

A Quaker



In a rigid building on soft ground the effect may be to rock the building or cause it to revolve about its center of gravity. These movements lessen the stresses in the upper stories. The taller the building the greater the tendency to rock.

designed to safely resist a horizontal force in any direction, at any horizontal plane, equal to one-tenth the total weight of the structure above that plane.

Earthquake Motion

The earthquake shock at the site of a structure is caused by an impact from the passage of an elastic wave. This wave originates deep in the earth from an earth-slip, probably along a fault line, or line of cleavage between vast fault-blocks. These faults are commonly many miles in depth, breadth, and thickness.

The elastic earthquake wave proceeds outward in all directions from its origin. It reaches the site of the structure under consideration, first as a longitudinal oscillation at right angles to the direction of transmission. The rate of travel of the elastic waves through the earth is from 2 to 8 miles per second, and the length of the waves may vary from 5 to 40 miles.

Many elastic waves may start almost simultaneously from different places along the earth-slip. Some of these waves will interfere with each other, and the elastic resonance of the earth formations through which they pass may filter out some and may emphasize others, thus lessening the confusion at the point of arrival.

Deep in bed-rock these waves seldom exceed a small fraction of an inch in amplitude of motion. They may become magnified in alluvial deposits near the earth's surface, so the violence of a wave motion near the earth's surface may vary largely in nearby localities. Moreover, the character of motion may change from a harmonic form commonly assumed into a form of oscillation similar to an elastic body struck a sharp blow.

Earthquake motion is assumed to be harmonic and to have a variable acceleration, similar to the motion of a pendulum. This may be true for the earthquake oscillation in solid rock, but experiments indicate the earthquake motion near the surface of soft ground does not follow the harmonic motion but presents much greater acceleration. The earthquake stress reaches its maximum at the instant of the reversal of motion.

Rules for the design of structures to resist earth shocks must be based upon definite assumptions regarding the motion of the ground. The common assumption is that the motion is translational; that is, all parts of the ground supporting the structure are at every instant moving in the same direction with a common velocity. All parts of the ground will have the same acceleration at every instant, although its value may be varying more or less rapidly in magnitude and direction. In most cases the predominating motion is translational, although it is not improbable to have rotational components causing dangerous stresses.

General Rule

Stress conditions throughout a structure at any instant depend upon the accelerations of all particles of the structure at that instant. Assuming these accelerations known, the general rule of procedure may be stated as follows:

Assume to act upon every particle of the structure and its contents a force equal to the product of its mass by its acceleration and opposite in direction to the acceleration. Treat the body as in equilibrium under the action of these suppositious forces in addition to the actual forces.

The actual forces include: (a) forces, such as dead weight and wind pressure, which are independent of earthquake motion; and (b) the supporting forces with values that may be changed materially by the earth motion. The former are a part of the known or assumed data of the problem, whereas the latter are unknown until computed by the aid of the above rule.

Conclusions

In the few years following the Long Beach earthquake there has been great advance in the studies and investigations of earthquake design, particularly in experimental investigation. Some of the old theories and ideas have been discarded in light of advanced study. There are still many unknowns to be evaluted. Structural engineers are still in disagreement regarding the forces to be resisted and the detailed methods of design. Though engineers are not able to accurately evaluate the forces of an earthquake, experimental studies, on models subjected to loads simulating earthquake action, are giving reasonable designs to resist earthquake shocks likely to occur. It is believed much greater progress will be made this way than by theoretical investigation alone, although theoretical studies must always supplement the experimental work.

In conclusion it may be of interest to summarize what engineers think they know today about earthquake-resistant design construction. The following statements are believed to summarize the present knowledge:

1. Foundations should be secure against settlement, and all the following statements assume stability of foundations.

2. The ground characteristics of the general area are of great importance in evaluating probable earthquake forces on a structure, different areas may have different characteristic periods of vibration.

3. In buildings with floors sufficiently stiff to act as distributing plates, the distribution of lateral force to the various structural elements is in proportion to their rigidities.

4. All vertical structural elements resist torsional moments in proportion to the square of their distances from the centroid of resistance, and also in proportion to their rigidities.

5. The centroid of resistance of the vertical structural elements should coincide with the centroid of mass of the building, or else the torsional moment must be provided for.

6. Buildings less than 100 feet high, whose height is not greater than twice their least base dimension, may be designed as rigid structures for a lateral force of one-tenth g, using ordinary working stresses and with reasonable assurance of no earthquake damage. With increased working stresses, say as high as one and one-half times the usual working stresses, the damage will probably be minor.

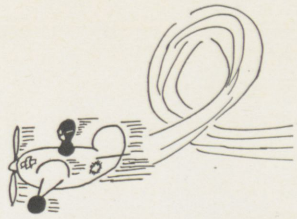
7. In all buildings, shear distortions are of much more importance than flexural distortions.

8. In addition to the fundamental period of vibration, the second and third modes may affect the structure, although to a lesser degree.

9. Increase in flexibility of the basement story, or the first story, results in decreased dynamic shears in the stories above, and offers a possible method of earthquake design.

10. Vibration experiments with models of buildings with structural steel frames and brick masonry walls, 16 to 29 stories in height, justify the tentative conclusions that tall office buildings must be regarded as flexible rather than rigid structures, and that they should be designed for dynamic shears. From these experiments it appears that the horizontal shear varies from story to story. Considering only the fundamental period of the building, and for the buildings studied, the story shears may be assumed to increase from one-twentieth g in the first story, to one-seventh g in the top story, the mass in each case being taken as that above the floor in question. In buildings with flexible first stories, these coefficients may be reduced.

AIRPOCKETS



by Earl O. Swickard, e., '40

"Airpockets" brings a pocketful of timely facts and figures concerning the former kiwis at Rose, now on the friendliest terms with the more intimate aspects of the troposphere. In fact for an authentic history of the first stage of civil aviation at the college, the assistant editor, a Junior Birdman in his own right, is thoroughly painstaking in his rendition of a complete account of this epochal program. Included are cost, requirements, adventures, and the content involved in the cloudster's course.

The Dawn Patrol flew for the last time March 20. Its 21 members assembled at the usual meeting time, 7:00 a.m., navigated through an hour quiz, and so completed the 72-hour ground course required by the C.A.A. (Civil Aeronautics Authority to the uninitiated) student flight program.

These ground school classes were accurately dubbed the dawn patrol for the class convened at 7:00 a.m. Monday through Friday and reference to an almanac will show that for the period from the middle of November to the middle of March sunrise took place after seven much of the time.

The Civilian Pilot Training course was brought to Rose mainly because of the efforts of President Donald B. Prentice and Professor Carl Wischmeyer. This course is identical with that being presented in over 500 universities and colleges in the United States. Last year was the first time it had been offered anywhere and then in only about 30 schools. Because of the apparent success in this first attempt, the program was expanded to what it is now. This year approximately 10,000 students are included by the C.P.T. Flying is ordinarily thought to be dangerous, and many times it is, but so rigidly is the course controlled and so carefully are the instructors selected that the number of casualities is amazingly low; lower, in fact, than was ever thought possible.

Easy Aces. The first class of Rose Tech airmen: front row, left to right, Earl O. Swickard, J. Edward Taylor, Maurice C. Fleming, Stanley R. Craig, Fred Thodal, and J. William Adair. Second row, Lloyd O. Krause, John E. Bartmess, Earl F. Michaels, Robert C. Brittenbach, and Third row, Maurice W. Johns, Aquila J. Hart, Edwin E. Gaston, Elmer D. Cooper, Winston H. Cundiff, and Willard V. Louthen.

Things in the ground school really got under way about the middle of November after several delays in checking physical examinations, insurance, and similar items. All of the 72 hours of ground work were taught by Professor Wischmeyer, and the record made by the 21 students on the C.A.A. exam attests to the excellence of that instruction. Out of 21 taking the two-hour, authority-prepared, "final" exam, 21 passed it the first time, a reasonably high percentage and much higher than anticipated by the Authority. The students enrolled in the ground school were: seniors, J. William Adair, Stanley R. Craig, Maurice C. Fleming, J. Aquilla Hart, Maurice W. Johns, Lloyd O. Krause, Willard V. Louthen, Earl O. Swickard, J. Edward Taylor, and Frederick Thodal; juniors, John E. Bartmess, Robert G. Brittenbach, and George R. Schull; and sophomores, Elmer D. Cooper, Allen D. Crane, Winston H. Cundiff, Edwin E. Gaston, Earl F. Michaels, Carlos A. Moore, Robert K. Morse, and John H. Taylor.

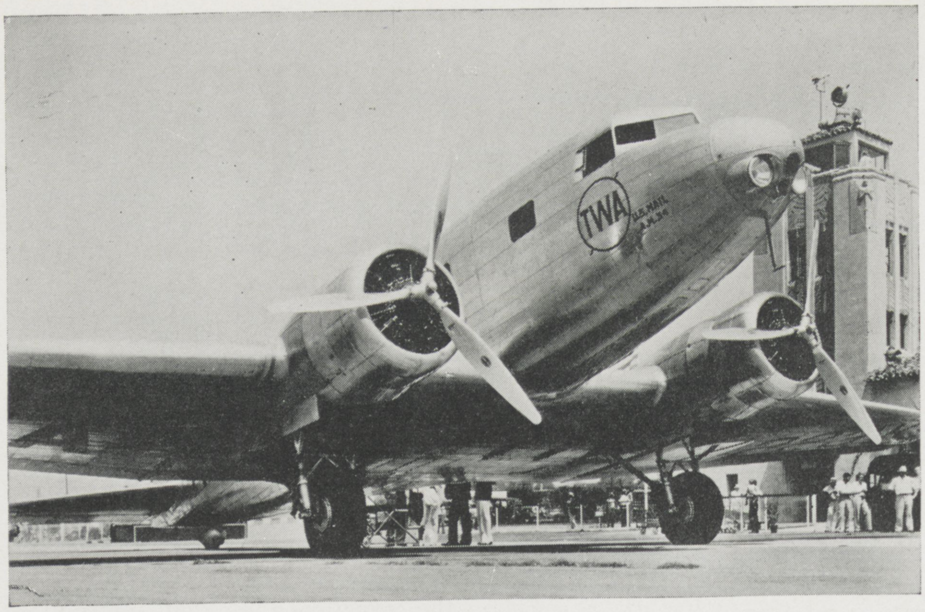
The 72 hours instruction received at Rose in ground school were divided as follows:

History of Aviation	2 hrs.
Civil Air Regulations	12 hrs.
Navigation	15 hrs.
Meteorology	15 hrs.
Theory of Flight	16 hrs.
Engines and Instruments	12 hrs.

The Authority furnished three texts from which the above components of the course were taken. These texts were supplemented by observations and lectures from the instructor, ably qualified to do this as head of the mechanical engineering department.

History of Aviation is self-explanatory.

Civil air regulations was composed of pilot rating, information concern-



ing the logging of pilot time, air traffic rules, aircraft registration, and parts of the Civil Aeronautics Act of 1938.

Navigation included chart reading, cross-country flying, air navigation by dead reckoning, and radio navigation.

Meteorology comprised the weather bureau's services, airway weather service, methods of weather observation, weather maps, charts and symbols, causes of weather changes, cloud formations, and fog causes.

Theory of Flight was made up of a study of the structure of air, forces on an airfoil, explanations of lift and drag, functions of ailerons, tabs, flaps, and tail surfaces, performance, and dynamic loads and factors of safety.

Engines and Instruments covered the operation of carburetors, valves and valve gears and cams, the ignition, the lubrication system, altimeter, airspeed indicator, gyro-horizon, turn and bank indicator, rate of climb indicator, inclinometer, pressure gages, magnetic compass, directional gyro, and radio procedures.

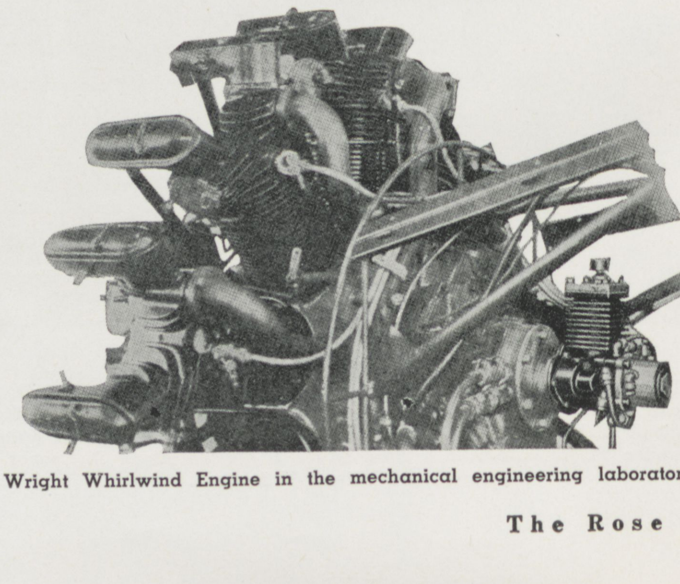
Because, for a while at least, the class took up while Apollo was yet resting, some of the boys were prone to sleep in after a strenuous night. This made for quite a few absences and more tardinesses. Considering, however, the absences due to ill health and other unavoidable causes, it is remarkable that so many of the classes were fully attended. There were a total of 86 absences out of 1512 student-hours, about 94.3% attendance, or about 4 absences for each student.

The actual flight instruction is carried on at Paul Cox field, home of the Dresser Aviation Company. Originally the instructors were Kenneth L. Buis, (Rose, '38) and Hugh Deffendall. Hugh, however, with over 2500 hours in the air, grabbed a position proferred by TWA after the flying program had been in progress about four weeks. To fill his place George Hale was taken off the roster as an I.S.T.C. instructor, the Normal boys not having yet begun to fly, and assigned to Deffendall's group. Kenny has the first ten as listed in alphabetical order and George the last ten. One of the students rejected from the flight course because of an eye defect is flying on his own time.

The physical examination required before permission is granted to take the course is the same one given to applicants for the civilian commercial certificate, which is next to the highest or airline certificate. There are the usual requirements of sound circulatory and respiratory systems, normal reflexes, and good muscular coordination. The part of the physical check-up which is a stumbling block for many is the eye and vision test. Besides testing for parallel vision and color blindness the prospective C.P.T. student must have 20-20 vision uncorrected, a pretty stiff requisite for many persons.

Above are listed what the student must possess. The plane, a Piper Cub, in which training is given, must also pass a certain standard. Briefly, this standard is: it must be an approved type, be in class 1 (under 1300 pounds gross), be powered by an engine of at least fifty horsepower, and be no older than three years. The cost of a Cub is approximately $1300.

The first phase of the beginner's flight instruction consists of learning the function of each control surface and the proper use of the stick and rudder to maintain level flight. Following level flight, practice consists of shallow turns to the right and left. Then come S turns over a road and figure eights about a point. During this instruction the student flies the plane himself, the instructor taking over only to demonstrate a maneuver or to correct a fault. Of course the instructor takes off and lands during this early period of the training, but the student "follows



Wright Whirlwind Engine in the mechanical engineering laboratory.

through" in order to familiarize himself with the sequence of movements. After about four hours the neophyte himself is allowed to make the take-offs and landings. When a minimum of eight hours dual instruction has been given, the eaglet may be permitted to solo. The first solo flight is a rare experience in one's life and the thrill of this first flight alone is seldom recaptured. Several students soloed during the winter and it was customary to roll the fledgling in the snow upon his return to *terra firma* and then allow him to buy the drinks.

The remainder of the course is spent learning and polishing the following maneuvers: shallow figure eights around a pylon, steep figure eights around a pylon, two-turn precision tail spins, recovery from stalls, forced landings, 720 degree power turns, 360 degree spot landings, 180 degree side-approach spot landings, 720 degree spiral over the spot with power off followed by a 360 degree spot landing, and cross country flying.

Professor Carl Wischmeyer, in charge of the Rose aviation school, bringing home the beacon at Paul Cox Field.

The flying, under the watchfulness of Kenny and George, has been free from any serious accidents. There have been, however, some rather humorous incidents. One student taxied into a boundary light, putting said light out of commission and breaking the propeller, a piece of equipment quite necessary to the proper functioning of an airplane. Three students, in an endeavor to make a three point landing, set the tails down so forcefully as to break the tail wheels. The crowning boner pulled was by the fellow who taxied into a poor defenseless cub and practically chewed the wing off it. The names of these careless fliers are soon to appear on the base of a little winged donkey. To have one's name so listed is to live forever in ridicule and ignominy.

The cost of this course is 24 dollars. This includes a six-dollar physical, a 14-dollar insurance policy, and a four-dollar laboratory fee. Another item of expense is transportation to and from the airport and meals bought at the airport to replace those missed. Many schools charged up to the maximum amount, 40 dollars, for this course. At 6 dollars an hour, the same course costs privately-instructed dodos about 250 dollars.

The crucial time in the course comes when the flight inspector says either "o.k.", "come again," or "N.G." So far Willard Louthen, Stanley Craig, Allen Crane, and Carlos Moore have received the "o.k.", and consequently their private pilot certificate. About the first of May there will be another group of five or six ready to take the flight exam.

The students taking this course are greatly interested in it and spend most of their spare time, and some not so spare, at the airport.

The enthusiasm shown by the Rose men may influence the C.A.A. favorably enough to institute the contemplated advanced course here next year. All are pulling for that addition to our curriculum and feel that this experience and instruction does not have its equal in any other single course. It is a sincere wish that the percentage receiving private certificates is as high as the percentage passing the ground work, and that the C.P.T. program is continued here at R.P.I. It is truly one of the opportunities offered to college students.

Did You Know That?

The human eye can distinguish differences among 2,000,000 colors and shades, it was reported before the joint annual meeting of the Inter-Society Color Council, the American Physical Society and the Optical Society.

So far 7,044 colors and their shades have been tabulated, it was reported by M. Rea Paul. Standard English dictionaries, however, list only about 3,400 words for these 7,000-odd shades, Mr. Paul said.—*The New York Times.*

Or That?

The greatest concentration of Gyro-Compasses in the world is on the Great Lakes of North America; in fact, one-third of all the Gyro-Compasses in the world's merchant service are essential in a locality almost a thousand miles from the nearest ocean.

BERYLLIUM ALLOYS

by Emil G. Christiansen, ch., '40

Beryllium and its alloys are generally not very well known. Beryllium alone is almost useless as a metal of fabrication because of its extreme brittleness. When used in small amounts with certain other metals, however, an alloy is produced having extremely valuable properties, such as high melting point, ability of ready hardening to any desired degree, extreme tensile strength, good ductility, and high resistance to corrosion. Such an alloy is that formed with copper. Herein is given a brief history of beryllium, its production, and the manufacture and properties of a number of its alloys.

IT has been said that the age in which we live might be called the "Alloy Age." Iron and steel alloys have found universal applications, while the progress in the use of aluminum alloys in the last thirty years has been truly amazing. Much less spectacular perhaps, but just as important, is the work being done on many other alloys about which little is known at present. These, when finally introduced, may prove to be as valuable as the aluminum alloys.

One of these little-known alloys is the class of beryllium alloys. It is the purpose of this paper to review the history of beryllium alloys and outline their characteristics and uses.

Discovery

Beryllium, also called Glucinum, is the third in a trio of light metals which science has brought the world in the last fifty years, the other two being aluminum and magnesium. The metal was discovered in 1797 by Vauquelin, but it was not until 1828 that Wohler isolated it. For about one hundred years beryllium remained essentially a laboratory curiosity. No commercial use was found for the pure metal and the admirable qualities of the alloys were not discovered. A beryllium-copper alloy was originally produced by Lebeau in 1897. However, he did not seem to realize its potentialities. Some time later, Corson, in America, discovered the heat-hardening capacities of beryllium-copper alloys in the presence of added nickel. Almost at the same time Masing and Dahl, two German scientists, discovered the heat-hardening properties of beryllium-copper alloys. The failure to realize the potentialities of beryllium alloys was due primarily to the difficulty of producing beryllium. Recently, however, patents have been granted on methods which make the production of beryllium commercially feasible. Engineers and metallurgists all over the world are putting beryllium to work. The present price of beryllium is fifteen dollars per pound in the form of an alloy with copper and is continuously dropping. It is predicted that beryllium in the next ten years may produce greater changes than aluminum in the last thirty.

Occurrence

The most important mineral containing beryllium is beryl, a beryllium - aluminum - silicate, $[Be_3Al_2(SiO_2)_6]$. This mineral contains eleven to thirteen percent of beryllium oxide. In New England an opaque form of beryl is sometimes found in the form of crystals twenty-five feet long, some of them weighing as much as a ton apiece. Substantial amounts are also found in South Dakota, Colorado, South Africa, Madagascar, Austria, India, and South America. Nowhere in the United States, however, is beryllium mined for its own sake. At the present rate of consumption in the United States (five hundred tons of beryl per year) enough beryl is produced as a by-product of other quarrying operations, such as feldspar quarrying, to more than supply the American beryllium industry. In spite of this, considerably more than half of the beryl consumed in this country is imported from India and South America.

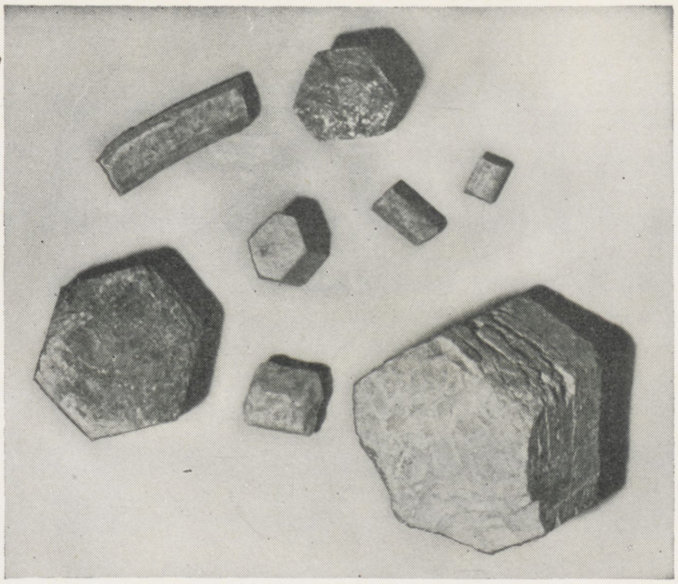
Much confusion results in the classifying of beryllium ores because of the inadequate means of analysis. As the use of beryllium becomes more widespread it is probable that methods will be developed to overcome this state of affairs.

Many other minerals containing beryllium exist, most of them unfamiliar. Beryllium occurs in the earth's crust to the extent of 0.0005 per cent, which places it between tin and arsenic in the order of occurrence.

Properties

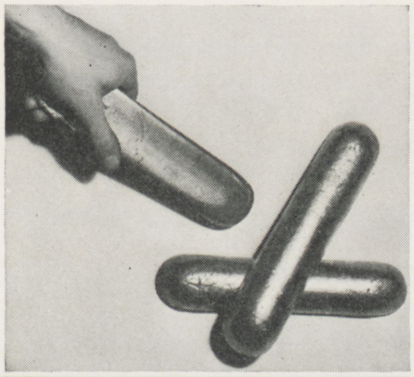
Beryllium, symbol Be, has an atomic weight of 9.02, as compared with an atomic weight for aluminum of 26.97 and for magnesium of 24.36. The pure metal has a density of 1.842 and a melting point of 1370 degrees C. It is a silvery white metal, malleable, and almost as hard as quartz. The electrical conductivity of beryllium is higher than that of copper. It is two-thirds as heavy as aluminum and about as heavy as magnesium. It has, however, an excess of 100 degrees C. in its melting point over both aluminum and magnesium, making it the only light metal which is stable at very high temperatures. Since the melting point of beryllium is close to that of iron, it might be supposed that it would resemble iron in some of its physical properties. This is borne out especially in the case of the linear coefficients of expansion and in the Young's modulus of elasticity. The calculated modulus of elasticity for beryllium, 30000 kg. per sq. mm., is approximately forty per cent higher than the modulus for steel.

According to Kroll the metallurgical handling of pure beryllium metal is still an unsolved problem. He classes beryllium with silicon in alloy habit and with chromium and bismuth in behavior under rolls. However, beryllium occurs with magnesium, cadmium, and zinc in the same part of the periodic table and has the same crystallographic habit as these metals—hexagonal close-packed. Beryllium exhibits a small degree of ductility except when it has been sublimed, when it has a higher degree of ductility.

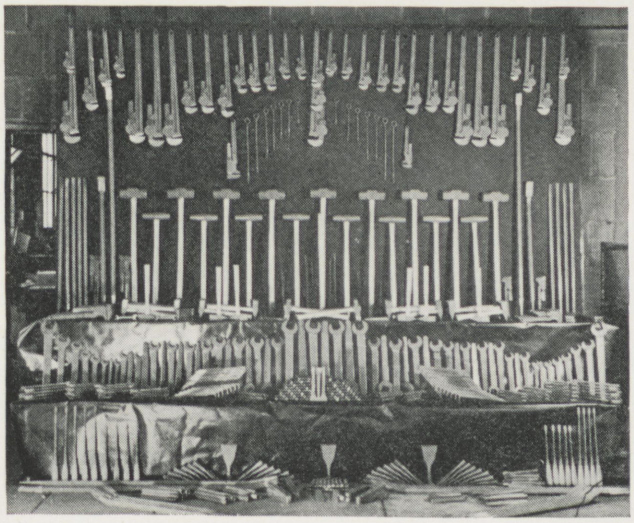


Cuts Courtesy Scientific American

Above: One source of beryllium—beryl crystals. Below: Master alloy—4 percent beryllium; rest, copper



Beryllium-copper tools find use near explosives because they won't spark, will easily cut cold-rolled steel, below



History and Production

The production of beryllium from beryl is complicated by the fact that powdered raw beryl is not attacked by any single acid except hydrofluoric. Because of this fact, alkaline fluxing is generally resorted to for "opening" the ore. With this method, however, alkaline metals are introduced which further complicate the remaining treatment. Beryllium oxide may be partially extracted from powdered raw beryl by first sintering the ore and then extracting with fairly concentrated, hot, sulphuric acid. The newest method in use in the United States, however, involves modifying the physical properties of the ore by melting and then quenching in water. This treatment makes the beryl more readily susceptible to attack by chemical reagents. This method was developed by C. B. Sawyer and B. R. Kjellgren in the United States. Patent No. 1823864 for this method was assigned to the Brush Beryllium Company of Cleveland, Ohio. The melting point of beryl varies anywhere from 1500 to 1600 degrees C., depending on its origin. This is well within the range of open-hearth melting. Investigation of the quenched beryl between Nicol prisms shows that it has lost its optical activity by this treatment. This indicates that the original crystalline structure has been destroyed, making it more susceptible to attack by sulphuric acid. The quenched beryl is then ground to 200 mesh and heated in an open vessel with 63 degree Be. sulphuric acid. The sulphated materials are ground and passed through Dorr leaching machines where the soluble sulfates, including those of beryllium, aluminum, iron, and alkali metals, are extracted. By the addition of an excess of ammonium sulphate the aluminum sulphate in the strong beryllium sulphate mother liquor is converted to ammonia alum which is crystallized and separated quantitatively. The essential feature of this operation, not heretofore recognized, is that the hot mother liquor must be saturated with respect to the beryllium sulphate at its final precipitating temperature in order to effect a complete separation of aluminum. Beryllium sulphate is then crystallized from the solution. Several crystallizations are necessary to completely free the beryllium sulphate from the iron and certain other impurities. The cost of the process may be almost completely recovered by the recovery of the by-products. The ammonium alum precipitated may be recovered in a high degree of purity and converted to anhydrous aluminum sulphate or aluminum oxide. Lithium, cesium and rubidium may also be recovered if present. In addition the reagents used in this process are cheap and standard and, if the scale of the operations warrants it, may be largely recovered.

The beryllium sulphate from this process is fed into a natural-gas-fired kiln and decomposed to beryllium oxide at a temperature of 1450 degrees C. The beryllium oxide may be used as it is or may be fluxed to the chloride or fluoride.

There exist several methods for the recovery of beryllium either pure or in the alloy form from the oxide. It can be produced alloyed by the direct reduction of the oxide with either carbon or hydrogen. It can be produced unalloyed by the electrolysis of the anhydrous fluoride or chloride, or by the chemical reduction of the fluoride or chloride with sodium or magnesium. Pure crystalline beryllium is produced by agglomerating the metallic crystals under pressure, melting in a vacuum, and then heating in an atmosphere of hydrogen up to 2500 degrees F.

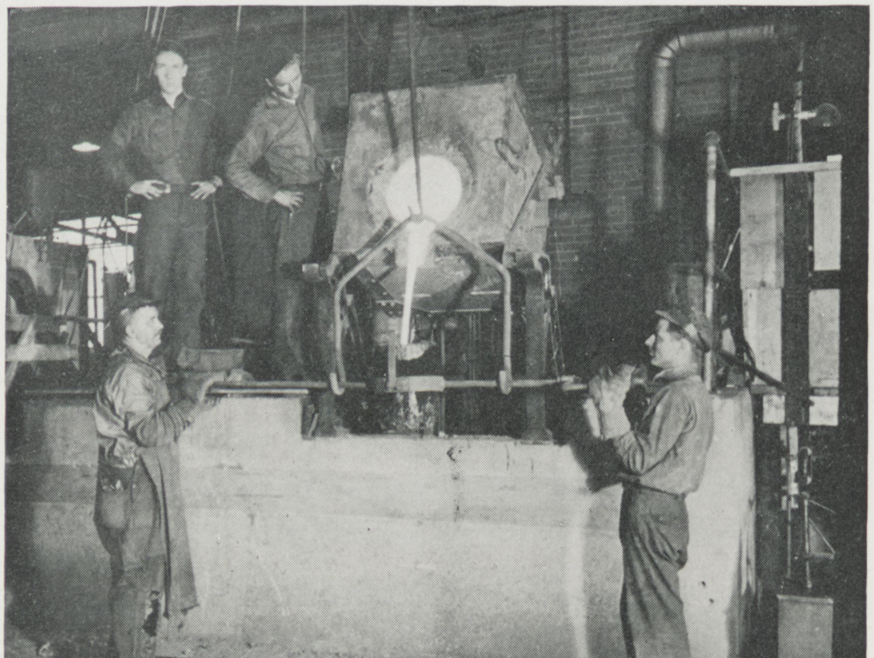
All of these methods show considerable commercial feasibility.

Uses of Beryllium

Because it is extremely brittle, pure beryllium is not likely ever to find a wide use. It is sometimes used as a material for windows in X-ray tubes because it is less opaque than aluminum. It may also be used as a substitute for calcium oxide in glass to increase the hardness and melting point. The disadvantage of extreme brittleness is apparently the only undesirable physical property.

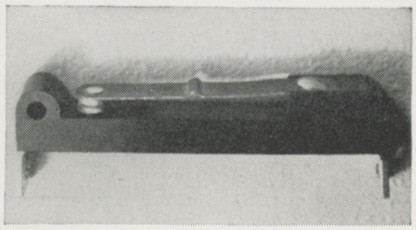
Beryllium-Copper Alloys

The largest commercial outlet for beryllium continues to be in various alloys with copper. When added to copper in small amounts it changes the properties of copper amazingly. Beryllium seems to be to copper what carbon is to iron. When added to copper in quantities resembling those of carbon, it develops properties in copper close to those of steel. Also, as in the case of steel, third and fourth metal additions to the binary alloy have been found beneficial. Some patent litigation has attended the progress of beryllium-copper alloys in this country. The discovery of the precipitation-hardening effect of beryllium in a ternary alloy with copper and nickel was patented in this country by Corson, an American research worker. At the same time the precipitation-hardening effect of beryllium-copper alloys with the addition of a third metal was patented in the United States by Masing and Dahl, two Germans. An interference between the two patent applications terminated favorably for Corson, with the result that the Masing-Dahl patent cannot read on third metal additions. When Dahl later sought a patent to generally cover third metal additions, Corson's work was cited against him and he withdrew all his claims except the one pertaining to the addition of chromium.



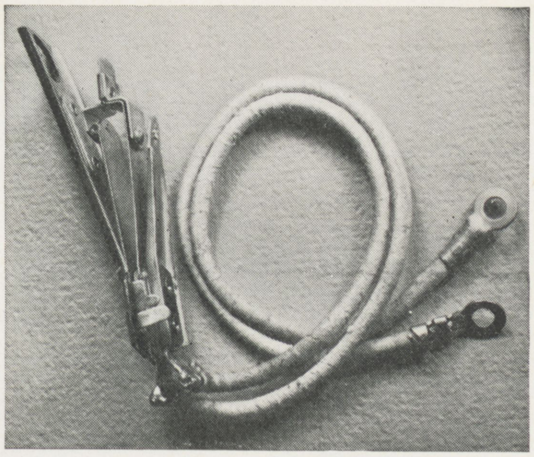
Cuts Courtesy Scientific American
Pouring a master alloy of beryllium and copper

Perhaps the most interesting and the most valuable characteristic of beryllium is its ability to render the copper alloy heat-treatable. Binary beryllium-copper will not harden, however, if the beryllium content is less than one per cent unless a third metal, such as iron, cobalt, nickel, or chromium is added, in which case an alloy containing as little as one-tenth of one per cent of beryllium may be heat-hardened. Heat-hardening beryllium copper differs from the same operation when applied to steel. The hardening of both requires that they be heated to a cherry red and immediately quenched. Steel emerges from this operation hard and brittle, whereas beryllium-copper after this treatment is soft and ductile and will withstand cold-forming operations. The next step in hardening, that of reheating to a low temperature, tempers steel, whereas beryllium-copper is first hardened, and on continued heating becomes soft. The important fact here is that the initial violent quenching leaves beryllium-copper in a soft, workable state, in which it can be machined, stamped, or drawn. The product may then be hardened by a gentle soaking at low temperatures with a minimum of deformation and inequalities of treatment. This is especially important in the case of complicated shapes. By heat-treatment a two per cent alloy can be given a hardness of 380 Brinell and a maximum ultimate strength in tension of 180000 pounds per square inch.



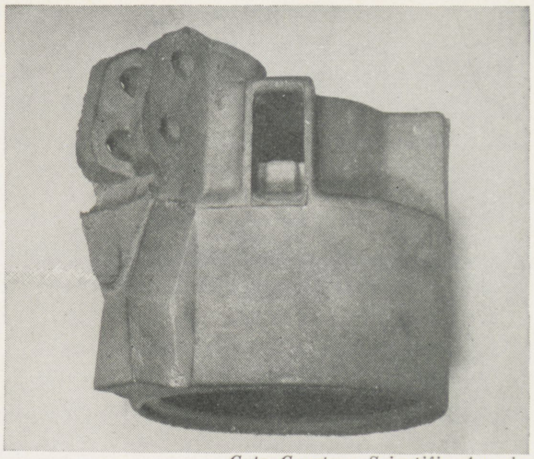
Typical use of beryllium-copper, for its fatigue resistance, in electrical contacts for time-control clocks

The electrical conductivity of heat-hardened beryllium-copper is more than twice that of steel, while a two to two and one-half per cent beryllium-copper has an electrical conduc-



Left: The thermostatic control for an automobile heater uses beryllium-copper spring contacts as shown at left end of this double cable.

Right: The same alloy, in cast form, is used in many kinds of electrical apparatus. The photograph shows the metal cast as a part of a circuit breaker.



Cuts Courtesy Scientific American

tivity at least seventy-five per cent higher than phosphor bronze, an alloy of copper and tin which is widely used in the electrical industry. In addition it can be stressed fifty per cent higher without taking a permanent set.

An outstanding quality of beryllium-copper is its high endurance limit (fatigue limit). This has been found to range from 35000 to 44000 pounds per square inch in air, but much more important is its ability to retain this quality even under severe corrosive conditions. Its endurance limit of 38000 pounds per square inch under a salt spray is higher than that of any other metal, including heat-treated alloy steel and stainless steel.

Beryllium-copper has a high elastic stability which makes it particularly valuable in such instruments as altimeters and for bourdon springs in pressure gauges.

The corrosion resistance of beryllium-copper under laboratory test conditions is about equal to that of deoxidized copper. When exposed to natural conditions beryllium-copper was found to be somewhat more resistant than deoxidized copper. In addition, there was no evidence of intergranular penetration in any of these tests.

The addition of a third metal to the binary beryllium-copper alloy produces some interesting results. An alloy containing 0.5 percent cobalt, two per cent beryllium, and the balance copper is an improved variation of the original two and one-quarter per cent binary alloy. This alloy has excellent electrical conductivity and particularly favorable age-hardening characteristics. It is heat-treatable to a hardness of 42 Rockwell C from the initial soft condition by holding for three hours at 600 degrees F. The cobalt containing alloys with 1.8 to 2 per cent beryllium have the advantage that they may be left in the furnace for several hours over the alloted time without danger of softening. This would be of considerable advantage in production heat-treating. Another type of beryllium-copper containing more cobalt than beryllium is especially noteworthy for two properties, electrical conductivity and heat resistance. Heat-treated strip shows a conductivity of about 50 per cent that of copper and a hardness 98 Rockwell B, together with a tensile strength of 110000 pounds per square inch. In addition, test specimens have been held for 80 hours at 780 degrees F. without loss of these properties.

Uses of Beryllium-Copper Alloys

Particularly outstanding is the use of beryllium-copper for springs because of the higher loading stresses permitted, the continued accuracy of calibration, and the high fatigue resistance. The substitution of beryllium-copper for phosphor-bronze has already been mentioned. The beryllium-copper alloy containing 0.5 per cent beryllium, 2.6 per cent cobalt, and the balance copper, also seems to have a bright future in the electrical field, especially in the manufacture of contact springs.

Another important use for beryllium-copper is in the manufacture of non-sparking tools for dangerous industries, such as oil refineries, explosives plants, and plants manufacturing photographic film. Aluminum-bronze is used most frequently where the tools do not have to withstand extreme service conditions. Where greater toughness combined with maximum hardness is required, beryllium-copper is preferred. Here again beryllium-copper's peculiar response to heat-treatment makes it desirable, since tools may be shaped and machined while soft and then heat-treated to the desired strength and hardness. Unfortunately, beryllium-copper tools cost about four times as much as do steel tools. Cost, however, cannot be a determining factor where human life is at stake.

Molds of cast beryllium-copper are being used as dies in the plastics industries. Beryllium-copper can be cast to reproduce intricate patterns, the steel dies for which could be made only at great expense.

Bearings and gears of beryllium-copper can be designed to withstand much higher unit loads than can be borne by any other metal. An example of this type of application is its use for the hub cones of adjustable-pitch propellers. The service conditions demand a material of high strength, high resistance to vibration, and the ability to withstand high bearing loads.

Experiments in the use of a binary one per cent beryllium-copper alloy for trolley wheels indicate the possibility of doubling the life of the wheel without causing undue wear on the wire.

GREAT MEN OF SCIENCE

by Nicholas A. Smilanic, e., '40

Joseph Henry
1799-1878

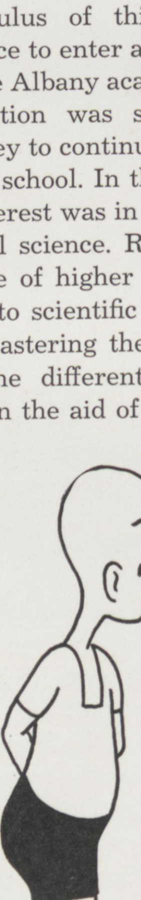
All the biographies so far having appeared on this page were those of Old World scientists. This month is presented that of Joseph Henry, one of the two that America may claim as its own among the early scientific discoverers. The other is Benjamin Franklin. Though working away from the great centers of research and at the same time struggling for subsistence from the soil, Henry somehow found the incentive to do research. Henry did his greatest work in the study of electromagnetism. His was the first notice of the peculiar effect of self-induction. The work that Henry did in other fields is equally amazing. Undoubtedly Joseph Henry may well take his place on this page with that of the Old World discoverers so far presented.

Among the early scientific discoverers, of whom the Old World boasts so many, America may claim two. They are Benjamin Franklin and Joseph Henry. They worked in the same field, but at different times. One identified the lightning from the thunder cloud with the electricity of the Leyden jar. The other was a pioneer in those electrical discoveries that have made possible the age of power in which we live. Even in the uncongenial atmosphere of America, away from the great centers of research with their galaxies of famous scientists, Henry made discoveries that won the admiration of his European contemporaries and caused his name to be known on two continents.

Joseph Henry was born at Albany, New York, in 1799. This country was still young, and the frontier did not extend far beyond the Ohio Valley and the Appalachians. Vast portions of his native state were covered with primeval forests, and, save occasional smoke from the white man's cabin, there were no visible signs of the forward march of civilization. In such inhospitable soil science does not thrive. Men are too busy in a first-hand struggle with the obstacles of Nature to devote much time to a consideration of the mysteries of energy and matter. But in the somewhat older east portion of his state Henry somehow found the incentives for a life of true research.

In his youthful days, Henry became interested in theatrical performances and wished to become an actor. He assisted in organizing a debating and amateur theatrical society, for which he wrote one comedy. But just at this time a seemingly trival event changed the whole course of his life. There fell into his hands a small volume entitled "Lectures on an Entirely New Direction."

The stimulus of this book led Henry at once to enter a night school and later the Albany academy. When his preparation was sufficient, he earned money to continue his studies by teaching school. In the Academy, his chief interest was in mathematics and physical science. Realizing that a knowledge of higher mathematics is essential to scientific research, he set about mastering these branches, including the differential calculus, without even the aid of a tutor. Following his academic courses, he applied himself to the study of medicine, making both ends meet by tutoring in the family of General Stephen Van Rensselaer. About this time Henry was appointed as engineer to survey a route for a road across New York state. He carried this out with great success. Much of the work was done in the dead of winter, through dense forests and deep snows, among the outposts of the new country. So attractive did this occupation seem to Henry that he was about to accept another engineering position when his election as Professor of Mathematics and Natural Philosophy in the Albany academy called him back to a life of scientific research.



Quick, Henry, the flux.
Apologies to C. Anderson

Henry joyfully took up his work in the Albany academy, where he soon developed into a lecturer and teacher of enthusiasm and rare power. But it was from his experimental researches in the field of electromagnetism that he drew the inspiration for his work. Sturgeon, in England, had just invented the electromagnet. But his invention was a crude affair. He had simply discovered that the magnetic field is greatly intensified by wrapping the wire loosely about a soft iron core. But neither Sturgeon nor any other European worker at that time had made a magnet of any considerable lifting power. Through the scientific publications from the European capitals, Henry kept himself posted on the discoveries of the past and the new advances which were constantly being made in this field. He repeated before the Albany academy all the old demonstrations with appartus devised by himself, much larger and more sensitive than anything ever before used. One of his most beautiful demonstrations was to show the influence of the earth's field upon the magnetic field of a large suspended coil consisting of many turns of fine wire, through which the current from a single cell was passed. In response to the attractive force of the earth's field, the coil immediately set itself at right angles to the magnetic meridian.

In 1831, Henry constructed a lifting magnet for Yale college which was made to support a weight of twenty-three hundred pounds. A little later he made one for his own laboratory which surpassed that in capacity by more than half a ton. Thus did Henry nearly a century ago do the experimental work which has made possible those giant lifting magnets now so widely used in the iron and steel plants of the world.

By 1831, Henry had become known as the foremost experimental scientist of America. As a result, he was called to be Professor of Natural Philosophy at the College of New Jersey, now Princeton university. After a short interruption Henry resumed his original investigations, but he now turned his attention to the new field of electromagnetic induction, or the production of electric currents from magnetic fields of force. This was the field in which Faraday did such distinguished work, but Henry preceded him, and, had he published his results earlier, his would have been the acknowledged honor for these discoveries. As it is, the credit due him is none the less. All of the experiments performed by Faraday were carried out independently by Henry. In his work he discovered for the first time the peculiar effect of self-induction, so important a factor in many electrical devices. In his later work on induction, Henry's experiments were performed on a much larger scale than those of Faraday. In one instance he induced strong currents in a secondary coil by means of a primary coil and battery placed in an adjoining room.

Henry was one of the first in America to make systematic investigations in meteorology and a study of the electrical disturbances of the aurora borealis. He discovered new phenomena connected with the cohesion of liquids. He did pioneer work on the subject of phosphorescence, and made determinations of the heat radiating power of sunspots. He carried out experiments on the capillary absorption of mercury by a number of metals.

When the Smithsonian institution was established at Washington through a grant of more than a half million dollars from James Smithson of London, Henry was made the first secretary, an office which he held until his death in 1878. In shaping the character of this institution during a period of more than thirty years, he served the cause of science as few other men have done.

THE ROSE TECHNIC

Member Engineering College Magazines Associated

Swan Song

With this, the April issue, the *Technic* staff performs its annual fade-out. There will be no blare of trumpets or roll of drums—just a typical "senior thesis sigh". And, if you've observed the seniors, you'll know that we do mean sigh. The sigh will, admittedly, be partially one of relief, but it will certainly contain a strong undercurrent of a kind of sadness. It's been work—hard work. But it's also been fun—great fun.

No swan song is complete without a "we-who-are-about-to-die-salute-you" note. And so this editorial farewell adds a note of sincere appreciation to the fine cooperation which has been given by the entire staff. But for really keeping things going, our thanks to the Gunga Din's of the outfit, faculty advisers Herman Moench and Henry Gray.

Finally we direct a brief remark at the new staff about to be inaugurated. We found this damn orphan on our doorstep a year ago and have tried, at least, to maintain it at equilibrium. It may be robust and it may be emaciated, but whatever it is, you've got it. And with it you have our best wishes that you will attain that for which we have striven.

—*An Editor*

Rose Alumni in Who's Who

In *Mechanical Engineering* for March, 1938, there appeared an article entitled "Alumni of the Engineering Colleges" written by Dr. D. B. Prentice, in which statistics were given concerning the graduates of colleges and universities of the U. S. and Canada listed in the 1931 and 1937 editions of "Who's Who in Engineering." In a list of 142 colleges and universities, Rose placed 33rd, having 71 alumni listed in the 1931 edition and 69 listed in the 1937 edition. Rose Tech, however, had only 1,498 graduates at that time, while most of the other schools which placed above Rose had from two to nine times as many graduates. When compared to eleven other strictly engineering institutions in the U. S., as to the percentage of graduates listed, Rose placed third with a percentage of 4.61. The two schools which placed above Rose were Michigan College of Mining and Technology (1,630 graduates) with a 6.13 per cent and M. I. T. (14,000 graduates) with a 5.44 per cent. These statistics are the latest available since the volume is published once every six years.

Thinking that it would prove interesting to both the alumni and the student body, a study was conducted to see how many of the 71 men listed had won the Heminway Medal, which is the highest obtainable scholastic honor at Rose. Since one of the qualifications for inclusion in the volume is ten to fifteen years of practical experience in the enginering field, the study was made to cover all classes from 1888 to 1920. During that period 34 Heminway Medals were awarded and 7 of the recipients are listed in "Who's Who in Engineering." This means that 20.5 per cent of the medal winners are listed in the volume or that 9.8 per cent of the 71 men listed were medal winners. Both figures are well above the 4.61 per cent for all graduates. Of the 7 men, two are professors and the remaining four are engaged or have retired from engineering positions. This bit of news may prove to be gratifying to most of the students. However, one must take into consideration the fact that some of the medal winners did not remain in the engineering profession and that some died before they had a chance to prove their worth. For instance, of the remaining 27 medal winners, two became lawyers, two entered sales work, one became a teacher, one entered business, two are unaccounted for, and two died before they had a chance to prove their worth. This reduces the number of possible men who could have been listed to 24. Taking this into consideration one can see that the percentage of medal winners listed is increased, that is, the per cent actually should be 29.1.

Did You Know That?

The price of rayon has been decreased from $4.60 a pound in 1920 to 7 cents today; as a result, close to 300,000,000 pounds of rayon are now utilized annually by Americans.

SURVEYING THE SCRIBES

Willis R. Lucas

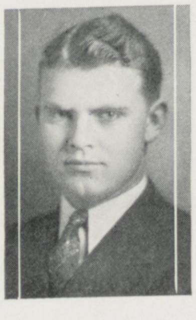
The paper on earthquake-resistant design is not the first of Willis' papers to appear in the *Technic*. Willis, a senior civil engineering student, has, as in his other papers, much of general interest in this writing. He is a member of the American Society of Civil Engineers, and he was the head of the Civil department during the recent Rose Show. Sullivan is his home town, and he naturally is quite proud of it because of its continuously outstanding football teams. He is dismayed or joyed in accordance with the fairing of the team. Willis played football here at Rose last year. It is when the baseball season begins that he shines as a walking encyclopedia. He can tell you who plays when, where, and why. It is fatal to your reading the sports section if he gets hold of it before you, unless you wait a while. Lucas is a College Inn exponent.

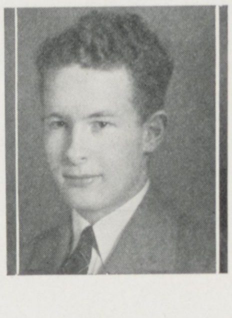
Earl O. Swickard

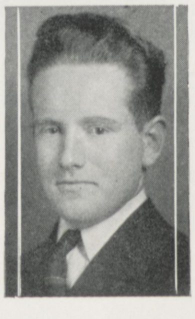
Earl wrote the C.A.A. paper especially for the *Technic*, one of those rare things that happens once in a while; that is, a paper *especially* for the *Technic*. Since Earl was surveyed in the last issue because of his having the paper on fluorescent lighting published, this month's survey must follow a different course. First it might be well to mention that at present, with 25 hours of flying time, Earl does not appear on the Paul Cox field C.A.A. donkey list, of which he spoke in his paper. Chances are he'll not make it. Earl is sort of a self-sacrificing soul as proven by his giving himself over to a certain girl in town for so long a time in the evenings that he sometimes is forced to walk out to the Inn, the last bus having come out without him. A word of recommendation might be given Earl here because of the fine work he did during the Show as chairman of the Power committee.

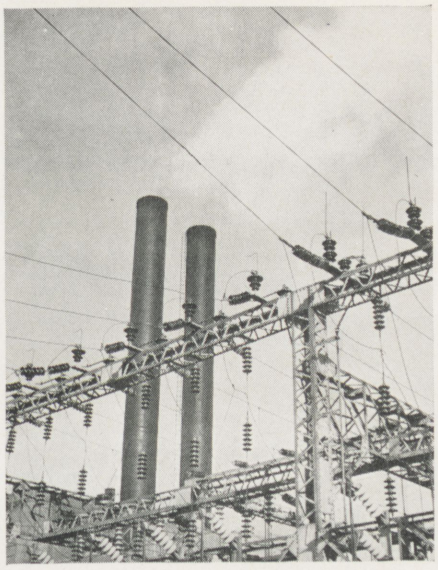
Emil G. Christiansen

Because chemists are always finding something new, it is perhaps only natural that a story about the debutante metal beryllium should be written by a chemical engineering student. Emil, who hails from Ellwood City, Pennsylvania, is a senior in the Chemical engineering department. As one quite interested in military he received just reward for his conscientious work in that ramification of his college career by this spring being appointed Cadet Major. Last year he was Cadet Master Sergeant. On the fair days of spring and summer the tennis courts are quite often trod by Emil's running feet and shaded by his flashing racquet. His is also the possession of a goodly number of pipes of varying shape, size, and age, which are all in their turn zealously smoked. Emil is a member of the American Institute of Chemical Engineers and Tau Nu Tau and was head of the Military department for the recent Rose Show.









Dresser Power Plant, 6 miles southwest of Terre Haute, will be one of Indiana's largest

RESEARCH AND DEVELOPMENT

edited by Hulit L. Madinger, ch., '42

The Dresser power plant located south of Terre Haute on the Wabash river will place a $4,500,000 addition in service about February of next year. This addition will increase the output from 75,000 to 125,000 kva. and make the plant one of the largest in Indiana. Even though the output will be much greater, the territory supplied will not be increased because of the steadily increasing load being placed on the plant by the additional use of electric stoves, refrigerators, and water heaters in homes. Some of the power cannot be traced because of interconnection with a national network, but most of it will be used in eastern Illinois and central Indiana.

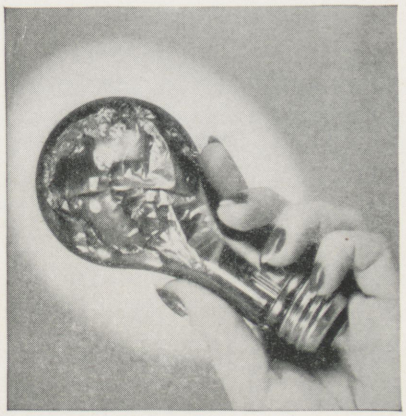
The water required by the plant will enter through a water intake house which is to contain revolving filters and a pump. This pump will maintain a pressure of 100 lbs. on the filters. The condensers, which operate at a pressure of one-half to one inch of mercury, require 120,000 gallons of water, supplied without purification other than chlorination. This chlorination prevents fungus growth and eliminates the necessity of stopping the machinery for cleaning. 400,000 pounds of water must be purified each day by evaporation to supplement losses in the closed system between the boilers and turbines. This loss amounts to only 2% of the 19-20 million pounds used each day.

The increased efficiency of the new equipment to be installed can be shown by comparing it with the old. The General Electric company is supplying the new turbine and generator. The turbine is a reaction type operating at 3600 rpm. to produce 50,000 kva. Two boilers, equipped with three-pass superheaters, will heat water by burning pulverized coal under forced and induced draft to provide steam at a pressure of 600 lbs. per sq. in. and a temperature of 750 degrees Fahrenheit. They are capable of evaporating 200,000 lbs. of water an hour. Three turbines and generators of the older type generate 75,000 kva. at 1800 rpm. Steam at a pressure of 335 lbs. per sq. in. and at 615 degrees is supplied by nine boilers. Eight of these evaporate 100,000 lbs. of water an hour while the ninth evaporates 187,000. All nine are heated by burning 1350 tons of coal a day on chain-grate stokers.

Two New Photoflash Bulbs

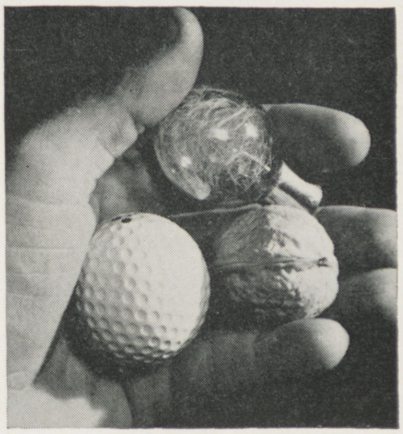
Now on the market are two new photoflash bulbs made by General Electric. They are being brought out just ten years after the first photoflash lamps were introduced. One of these new bulbs is about the size of a walnut or golf ball, and two dozen can be carried in the pocket of a suit coat, more than three dozen in the pocket of an overcoat or a lady's handbag. The bayonette type base of the lamp is similar to that used on automobile lamps. The filament is a fine wire. A lacquer coating is placed on the surface to serve as a safety jacket. This small lamp is rated a total light output of from 13,000 to 15,000 lumen-seconds. Two or more dry cells are used to fire the flash. The 110-volt current previously used is not suitable. The bulb is designed for use with all cameras except those having focal plane shutters. It will make possible smaller and less cumbersome reflectors and flash equipment.

The other new lamp which has been announced is designed for use with color film. The light is balanced for photographic purposes by means of a blue filter. A lacquer coat containing the corrected blue coloring matter provides this filter.



Cuts Courtesy General Electric

Flash lamp for increasingly popular color photography.



Walnut-sized, 15,000 lumen-second, photoflash lamp.

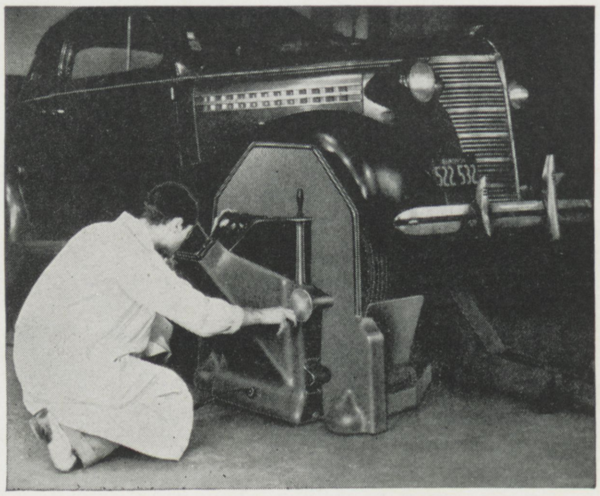
Because the light is similar to natural daylight, it can be used ideally in combination with natural daylight.

X-rays to Diagnose Tire Ills

The safety of a tire can now be determined easily and definitely by any filling station attendant with a new x-ray fluoroscope. Breaks, bruises, cord separations, and other hidden failures as well as such foreign objects as tacks, nails, wire, screws, glass, and stones can be detected without removing the tire from the automobile. This device can be used on all types of passenger cars and small trucks, but not on large buses and trucks. White sidewall tires contain zinc oxide, a material which makes them relatively opaque to x-rays. However, tires up to and including an eight-ply white side-wall tire can be inspected with this fluoroscope.

A single standard electric light outlet is required as a source of power. The instrument is made shockproof by immersing in oil all high voltage parts, including transformers and the x-ray tube, and grounding the metal container. Flaws in the tire may be marked by a push-button controlled device. The line switch is governed by a removable key to prevent the operation of the equipment by the curious. Tube life is prolonged by a switching arrangement which energizes the x-ray tube only during exposure. A voltage selector makes the tube versatile enough to examine both thin and heavy tires.

In order to examine the tires on a car, the car is jacked up until the wheels are about nine inches above the floor. The fluoroscope is then centered in line with the axle and as near the tire as possible without touching. A brake is then applied, and the protective end-shields of the x-ray are raised into place. The tire is inspected through a viewing hood. This instrument is the result of several years research, and much that has been learned about x-ray in other commercial and medical fields has been applied in its design. The designers believe that the use of this instrument will reduce the number of accidents caused by tire failure and will increase the tire sale and repair business of filling stations.



Courtesy General Electric

View of X-ray flouroscope being used to examine casing.

Nylon

Rising from the stubble of a cornfield in Delaware is a mammoth plant which is destined to become the birthplace of the latest triumph of chemical research—nylon. Nylon is a recent development of the du Pont research laboratories, the same laboratories which have produced cellophane, lucite, pyralin, and many of the other plastic creations which have been developed in the last decade.

By June this factory will probably be operating on a full production scale and nylon will quickly become a household word. Nylon is a remarkable new textile which is unlike any known before. It is like rayon in that it is prepared artificially by a chemical process, but, unlike rayon, nylon is not made from cellulose nor does it have a cellulose base. Instead, it is a protein and is stronger and more elastic than rayon.

Nylon resembles silk in some ways so that it can be easily confused with silk, but it cannot be called synthetic silk since nylon and silk do not have the same chemical composition. Nylon may be used instead of silk for fishing lines in the near future because its greater elasticity and strength make it much more desirable to fishermen.

Although nylon does not have an exact chemical counterpart in nature, it has somewhat the same composition as the proteins, of which silk, hair, and wool are common examples. Moreover, nylon cannot be given one definite chemical formula because the term is used in referring to the family of related synthetic compounds, the polymides. The name "nylon" actually refers to the polyamide itself, from which the fibers and cloth are formed.

At the new plant in Delaware, the nylon in molten form is forced through a spinaret by a pump. Upon striking the cool air the filaments solidify or "freeze." These solid filaments are wound up and twisted a few turns to make their handling easier. The bundle of fibers, now called yarn, is then stretched to impart the strength and elasticity which is characteristic of nylon fibers. This stretching process arranges the molecules in an orderly array, rather than in their former helter-skelter pattern. The drawing out of the fibers is executed by a machine which winds the yarn from one spool to another several times faster than the spool which is unwinding. The yarn is then put into bolts for sale as yarn or else is further treated and sold as a finished product. Other applications range from toothbrushes to parachutes, and don't forget the ladies hosiery angle.

Since the industry is entirely new, the new factory cannot operate at top speed until preliminary problems have been ironed out and until men have been trained to operate the new type machines which will be used in the Delaware plant.

Low-cost X-ray

The use of the x-ray has long been recognized for the diagnosis of tuberculosis. Unfortunately the cost of the large x-ray plates is so high that the availability to a great number of

RIGHT OR WRONG?

A 2-minute test for telephone users

1. It's impossible for you to telephone to people in two different cities at the same time.

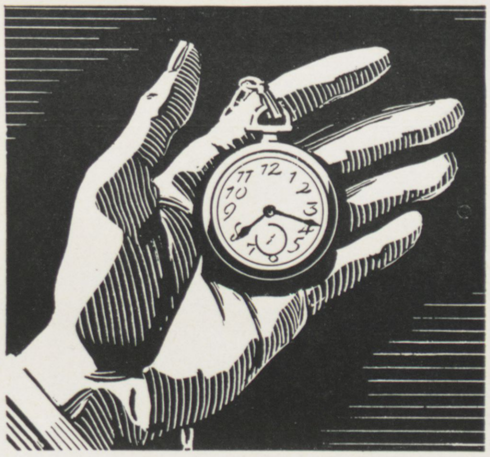
RIGHT ☐ **WRONG** ☐

2. Police Radio Telephone made by Western Electric is an outgrowth of research at Bell Telephone Laboratories.

RIGHT ☐ **WRONG** ☐

3. About 75% of the Bell System's 85 million miles of telephone wire is contained in cable.

RIGHT ☐ **WRONG** ☐



4. Lowest telephone rates to most out-of-town points are available every night after 7 P. M. and all day Sunday.

RIGHT ☐ **WRONG** ☐

ANSWERS:

1. *Wrong.* Telephone Conference Service enables you to talk simultaneously with as many as five other people.

2. *Right.* And that's true also of broadcasting equipment, aviation radio telephone and marine radio telephone.

3. *Wrong.* Over 95% is now protected by cable — nearly ⅔ of which is underground.

4. *Right.* Why not telephone home oftener? Your family will enjoy it—so will you!

BELL TELEPHONE SYSTEM

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — BELL SYSTEM people has been limited. Previously, exposures were made on regular 14- by 17-inch film. This size was necessary to include all of the chest. A new photo-roentgenographic unit has been designed to make complete photographs of reduced size on a 4- by 5-inch film. This considerably reduces the cost and extends the application of x-ray diagnosis. In this machine, the image which is formed on a special fluoroscopic screen by the x-ray exposure is photographed by means of a f: 1.5 lens. The films used are only about one-eleventh the area of a standard x-ray photograph. Substantial reductions can be made in film, film-processing, and film-filing costs. The result of the use of this new unit will undoubtedly be that a great many more patients may be served on existing budgets.

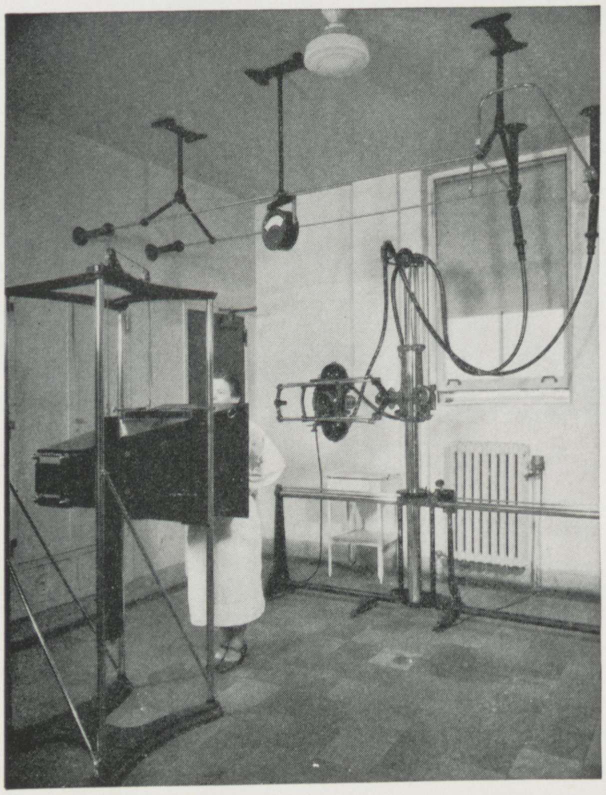
Powerful X-ray for the Bureau of Standards

The medical profession has been using x-rays for several years in the treatment of cancer and other diseases. The Bureau of Standards in Washington covers methods for dosage measurement for voltages up to 400,000 volts. The present trend, however, is to use ever increasing voltages. For this reason a new 1,400,000-volt x-ray tube is being built for the Bureau of Standards. This tube, which is built in ten sections, is twenty-eight and one-half feet long. To provide the necessary current a powerful, constant-voltage d-c generator is also being built. Since great flexibility is important, the tube can be operated at any voltage between 300,000 and 1,400,000 volts. The electron beam travels 24 feet from the cathode to the target. In order for the tube to be used effectively the electron beam must be of the proper size and must be aimed accurately.

The multisection construction permits a method of applying energy to the electron beam in each section. In each section of the tube the beam is given an additional velocity corresponding to 140,000 electron volts. The speed of the stream at the end of the path is very near the velocity of light.

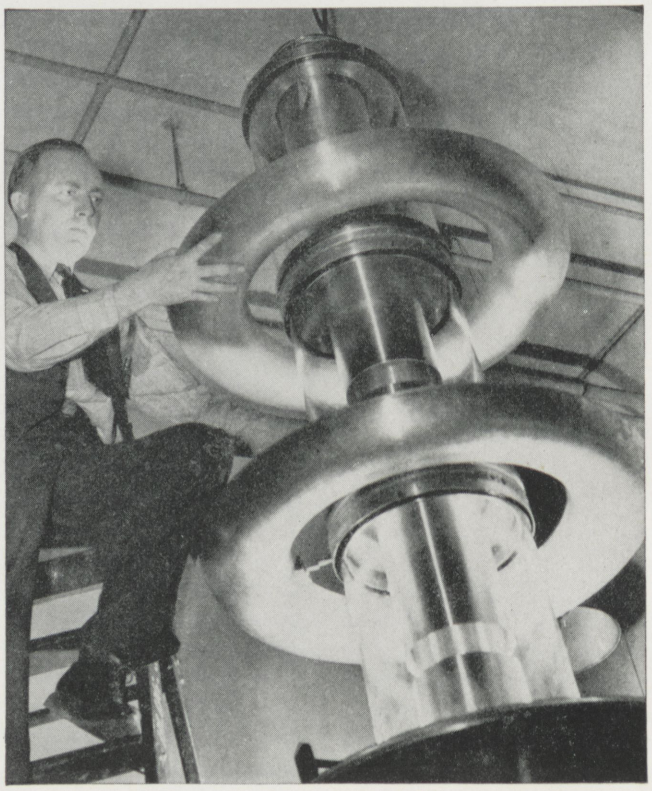
4,242 *Wire Cable*

A new telephone cable has been designed by the Western Electric company which carries 606 wires more than the largest previous cable. There has been no increase, however, in the diameter of the cable, which is two and five-eighths inches. No change has been made in the size of the wire, but the reduction of size was accomplished by an improved technique of insulation. A small reduction of only 0.003 inches in the thickness of the insulation made possible the addition of the extra wires. The insulation consists of paper pulp coated directly upon the wire. This thin coat replaces the previously used insulation of paper ribbon wrapped spirally around the wire.



Courtesy General Electric

Four- by five-inch radiographs replace the much more costly 14- by 17-in. radiographs when this photo-roentgenographic equipment is used



Courtesy General Electric

1,400,000-volt X-ray tube for use in combating cancer growth.

Student Council-sponsored St. Pat's Dance, held at the South Club, repeats former successes.

CAMPUS MERRY-GO-ROUND

edited by Earl F. Michaels, e., '42

Glee Club

The Glee club held its first concert of the school year and its first concert under the direction of Mr. Taflinger at the Gerstmeyer Technical high school on Monday, March 18.

In addition to presenting a program at the Clinton high school during the latter part of March, the club accepted an invitation to sing at the opening of the new Y. M. C. A. building in Terre Haute on March 29.

School Records Audited

The balances of the school records successfully passed the exacting eyes of the auditing committee. Stanley, no doubt, must have done a masterful piece of bookkeeping in order to satisfy Max Mitchell and William Hales, chairmen of the auditing committee. John Combs, succeeding Stanley Craig in the office of financial secretary, has now started to execute his duties as financial secretary and will continue to do so until next spring.

Attention, Census Bureau

This is not Walter Winchell going to press, but only your humble reporter wishing to announce a very special and blessed event. FLASH! —On Monday, March 18, Mrs. Arnold Jones presented her husband with a bouncing seven-pound baby girl, who was christened Frances Ann.

For the few who do not know Arnold, he is a Junior at Rose taking mechanical engineering. He transferred from the University of Oklahoma in his Sophomore year and during his two years at Rose has come to be one of the best liked men on the campus.

All day Monday one could walk through the school and see students busily engaged in smoking cigars received from Arnold. We all wish to thank him for his gifts of the fine cigars.

A. S. C. E.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

The March meeting of the Rose chapter was held in the University club rooms at the Deming hotel. At this time a talk was presented by Mr. Stoll, Indiana representative of the Portland Cement association. The subject he had chosen was "Construction Methods as They Affect Reinforced Concrete Design." The content of his talk was very interesting, especially to the upperclassmen present, as it furthered their study of this phase of concrete design. Mr. Stoll accompanied his talk with slides pertaining to the subject which greatly helped to explain certain details.

A dinner was held in the club rooms on the same evening. Professors MacLean and Hutchins, Mr. White, Captain Henney, and the officers of the chapter were present.

Debate Club

With the coming of spring, the Debate club closed a very productive season. The longest and most significant trip of the year was the journey to Huntington, Indiana, to participate in the annual Manchester-Huntington tournaments. These wars of words were conducted during a period of two days—February 23 and 24. Four members of the club, Robert D. Phelps, Hulit L. Madinger, Robert D. Parr, and Gene F. McConnell, and the debate coach, Mr. Leroy Brown, made this trip. This gigantic gathering of oratory addicts represents "tops" in debate tournaments, for it consists of about 235 different teams representing some 100 schools. Each team engages six other teams in verbal combat. Taking all things into consideration the Rose team did very well in carrying off two victories.

The club is planning on having a dinner in the near future at which time plans will be discussed for next year's club, and keys will be presented to three men who have served the club during the past two years. These men are Robert D. Phelps, Hulit L. Madinger, and Gene F. McConnell.

Since new men have been familiarized with the work this year, the club is anticipating an even more successful season when it comes time to toss around those invigorating forensic blasts next year.

"Let There Be Light"

It was neither the heat nor the fact that he was thinking. Neither can it be blamed on the pretty girl who was walking past the window. The reason that he ran into the door frame in broad daylight was that he had been drawing all morning and just wasn't all there—neither was the door frame after his passage.

Consequently, it is announced with great pleasure that a much needed improvement is to be made in the lighting system of the drafting and machine design rooms. The inadequate lighting which has prevailed in past years is to be replaced by individual fluorescent lamps. A great lessening in eye-strain and a considerable increase in efficiency on the part of the students is expected to result. The installation of 50 of these lamps in the drawing room and 20 in the machine design room will require a new wiring system. At present the plan is to place the wiring under the floor and lead the wires up the desks to the individual lamps. This work will not be completed until summer.

Without benefit of Burma Shave.

"Coming-out Party"

What ho, the guards! Perhaps those aren't the *exact* words used, but they might convey the general impression of how several astonished students felt recently upon being confronted by a snarling, vicious mob. The victims pleaded, ran, and tried bribery, but all to no avail. They were apprehended and by malfeasance shorn of products of months of intensive labor, their mustaches. The resulting revelations were most gratifying—it seems as if the boys did not have criminal records after all. Be that as it may, your reporter is prone to believe that there was a tinge of jealousy in it all. Some of the seniors had to act before underclassmen's ability to grow "soup strainers" was manifested too conspicuously.

A. S. M. E.

The Rose student branch of the A. S. M. E. was host Friday evening, March 15, to the central Indiana section of the society.

Mr. Robert H. Kuss, technical adviser to the Smoke Abatement League of Terre Haute, presented a paper on "Municipal Control of Atmospheric Pollution." The speaker, a graduate of the University of Illinois, gave a most interesting talk, drawing from extensive experience gained as special observer for the fuel testing division of the United States Geological Survey in four hundred steam boiler tests and as engineer for the recently organized Chicago department of smoke inspection. Mr. Kuss' professional work includes power plant control work, sales engineering, and heavy-chemical plant design.

The address, given at Deming Hall, was preceded by a dinner. Professor Wischmeyer, society executive committee member and head of the department of mechanical engineering, was in charge of the meeting.

At a meeting held Monday, March 18, Arnold Jones was chosen as the speaker to represent the Rose student chapter at the annual sectional A. S. M. E. meeting to be held in Chicago on April 15 and 16 at the Stevens Hotel.

At Last

The general cleanup before the Rose Show seems to have accomplished a miracle. After eighteen years, the painting of the hallway and stairs leading from the chemistry laboratory to the boiler room has become a reality. The two-color scheme of ivory and brown used in the machine shop was continued to the chemistry laboratory which we hope will be painted in the same manner. The recent painting has bettered the illumination of the stairs and has also tended to connect the new industrial laboratory with the chemistry laboratory.

The New Catalogs

The Rose Polytechnic Institute bulletins for 1940 recently arrived and were made available to the students. This in no way, however, meant that the work of distributing the catalogs was completed. Miss Gilbert and an able staff of volunteers have mailed almost 3,000 copies of the bulletins to alumni, factories, schools, and prospective students.

Hoop Review

Although the Enginers did not fare so well as they had hoped, the season was by no means a failure. After a poor start—the Engineers lost five games in a row, and lack of practice undoubtedly had something to do with it—Rose won four of the next five games, lost two on the road, and finished with a decisive victory. The record books show five wins against eight losses.

The high-lights of the season were the successive victories over Earlham and Oakland City. In both games the Engineers were decidedly the underdogs, but they displayed their best basketball of the year to upset the dopesters to the delight of enthusiastic home audiences.

The record:

Rose	27	DePauw	32
Rose	32	Earlham	42
Rose	34	Wabash	39
Rose	45	Taylor	48
Rose	29	Oakland City	57
Rose	45	Taylor	41
Rose	28	Wabash	50
Rose	51	Aurora	39
Rose	36	Earlham	33
Rose	54	Oakland City	42
Rose	35	Aurora	42
Rose	29	Joliet	42
Rose	41	Concordia	23

Some interesting statistics:

Rose—Free throw percentage—116/211—.549.

Opp.—Free throw percentage—110/176—.625.

Rose—Field shot percentage—185/1018—.181.

Rose—Game average of field goals—14 3/13.

Opp.—Game average of field goals—16 1/13.

Rose—Average points per game—37 5/13.

Opp.—Average points per game—40 11/13.

Individual records:

	FG	FT	FTA	PF	TP
Colwell, Capt.	58	24	48	21	140
Meurer	53	32	58	15	138
Bowsher	28	11	21	34+	67
Dreher	12	10	15	5	34
Keeler	13	8	13	18	34
Mehagen	6	15	22	17	27
Harper	7	6	13	27	20
Brown	5	3	8	4	13
Norwalk	3	0	0	1	6
Logsdon	0	4	4	2	4

+ Technical Foul.

At the end of the season major letters were awarded to Captain Robert Colwell, Joseph Dreher, George Harper, James Brown, Harold Bowsher, Irvin Keeler, John Mehagan, and Charles Meurer.

Intramural Basketball

Again this year, as last, the intramural league was a round-robin affair, the teams representing the departments of the school. In the final game, also as last year, the Civils defeated the Mechanicals for the championship. At the present writing, however, a formal protest filed by the Mechanicals is being considered.

In the opening game the Civils defeated the Chemicals 25-12. At half-time the Chemicals had made only two points to the Civils 11. The Mechanicals established themselves as favorites for the title with a crushing 53-26 victory over the Electricals, and the Civils routed the same Electricals 34-14. The Mechanicals walloped the Chemicals 35-14 to remain tied for the lead. In the next game the Chemicals won the dubious honor of being cellar-champions, losing to the Electricals 30-11.

In the final game the Mechanicals, without the services of their high-scoring center lost a hard-fought game to the Civils. The score was 19-12.

Did You Know That?

From Berkeley, Calif., comes the observation by Dr. Emil Bogen, National Safety Council committee member studying intoxication tests, that fat men can drink more than thin men under normal conditions. The reason is that intoxication is caused by concentration of alcohol in the blood stream; fat men usually have more blood than thin ones.

—*Science News Letter*

Left to right—Quinn, Bowsher, Norwalk, Mehagan, Logsdon, Huffington, Keeler, Colwell, Dreher, Brittenbach, Beurer, Brown, Harper and Mullins.

GRADE A GRADS

edited by John E. Bartmess, m., '41

THE ENGINEER

Who is the man that designs our
pumps with judgment, skill and
care?
Who is the man that builds them
and keeps them in repair?
Who has to shut them down because
the valve seats disappear?
The bearing-wearing, gearing-tear-
ing Mechanical Engineer!

Who makes his juice for half a cent
and wants to charge a dime?
Who, when we've signed the con-
tract, can't deliver half the time?
Who thinks a loss of twenty-six per
cent is nothing queer?
The volt-inducing, load-reducing
Electrical Engineer!

Who is it takes a transit out to find
a sewer to tap?
Who then with care extreme locates
the junction on the map?
Who is it goes to dig it up and finds
it nowhere near?
The mud-bespattered, torn and
tattered Civil Engineer!

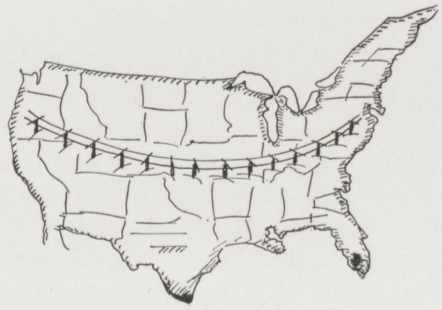
Who thinks without his products we
would all be in the lurch?
Who has a heathen idol which he
designates Research?
Who tints the creeks, perfumes the
air and makes the landscape
drear?
The stink-evolving, grass-dissolving
Chemical Engineer!

Who is the man who'll draw a plan
for everything you desire?
From a trans-Atlantic liner to a
hairpin made of wire?
With "ifs" and "ands", "howe'rs"
and "buts," who makes his mean-
ing clear?
The work-disdaining, fee-retaining
Consulting Engineer!

Who builds a road for fifty years
that disappears in two?
Then changes his identity so no one's
left to sue?
Who covers all the travelled roads
with filthy, oily smear?
The bump-providing, rough-on-rid-
ing Highway Engineer!

Who takes the pleasure out of life
and makes existence hell?
Who'll fire a real good looking one
because she can not spell?
Who substitutes a dictaphone for a
coral-tinted ear?
The penny-chasing, dollar-wasting
Efficiency Engineer!

Thanks to a grad of the class of '18.



Transcontinental Telephone line Builder.

George A. Kelsall

George A. Kelsall received his early education in the public schools of Louisville, Kentucky, and was graduated from the Male high school of that city. He worked for three years, and, in 1902, entered Rose. He was graduated from Rose in 1906 with a B.S. degree in electrical engineering. In 1938 he received the degree of Electrical Engineer.

Mr. Kelsall spent three years, after graduation, with the General Electric company at Schenectady and with the Indiana Steel company at Gary. In 1909 he went to Michigan State College as instructor in electrical engineering, where he remained for three years. Joining the Western Electric company in New York in 1912, he took a very important part in the development of the remarkable new magnetic materials which have since come to be known as permendurs, permalloys, and perminvars. His first five years with the company were spent loading coils in the physical laboratory. During this period, taking part in the development of powdered-iron core material, he developed an a-c permeameter for measuring the permeability of toroidal cores. This has been a large time-saver as it does not require winding the specimen. These permeameters have been used continuously in the laboratories in development of the new magnetic alloys and in the inspection of magnetic cores. He also developed the permeameter furnace for measuring a-c permeability at elevated temperatures. Since 1917 his efforts have been directed toward fundamental studies of magnetic materials. During this time he has investigated about twenty-five hundred alloys with different compositions; and because of his extensive knowledge of these alloys he acts as consultant in problems relating to their properties.

"Permeameters for Measurements Over Wide Temperature Ranges" was the title of an article written by Mr. Kelsall for the *Bell Laboratories Record*. The article was reprinted in the January, 1930, *Technic*.

Mr. Kelsall states that one of the most interesting jobs—and now of historical interest too—was the completion of the first transcontinental telephone line. For his services in this project he was, on July 28, 1939, awarded a certificate of membership in the Society of Planners and Builders of the First Transcontinental Telephone Line.

On February 10, 1917, Mr. Kelsall was married to Hannah Helena Diggles. They have three children, Helen Diggles, age 21, Avery Crowell, 20, and Ann Lewis, 15. Helen was graduated from Vassar with honors last year, and is now in Radcliffe College, Cambridge, Massachusetts, where she has a fellowship in mathematics. Avery is a senior at Rose this year and is in the electrical engineering department. Ann is a sophomore in Belleville high school, Belleville, New Jersey.

Larry (Avery) Kelsall

Mr. Kelsall states that he would advise a young man to study engineering—"if he has the right aptitudes." He also states that had he to do it over again, it would be engineering—and at Rose. When asked what in his opinion are the prime requisites of a "successful life" he said, "The right combination of ability and perseverance and the choice of a career which fits your particular aptitudes. It is a decided advantage to find out early what these aptitudes are."

Alumnus Over the Top

Kenneth L. Buis, "Prof" to several of the fellows who are participating in the government's civil aeronautics training program, was graduated from Rose in 1938. His winters, directly before entering Rose, were spent in (hard) study in Wiley high school of Terre Haute and his summers as an officer in the Terre Haute Boy Scout camp. It was only natural, therefore, that as a son of the beautiful city on the banks of the Wabash, he entered Rose in 1934, upon his graduation from high school. About this time, some kind soul gave Kenny a ride in one of those machines that dynamically "float" through the air, and from that time on he was more at home "up in the air" than on good Terre Haute soil. While at school, he was a member of Alpha Tau Omega fraternity and the Tau Nu Tau military fraternity. As a result of his activity in the advanced military course he received, upon graduation, his commission in the reserves.

After graduation he became a flight instructor, first at Terre Haute, and then at Indianapolis. Indianapolis, however, did not seem to hold the ties on his heart, and so he returned to Terre Haute as an instructor for the Dresser Aviation company at Paul Cox Field. This fall he received his re-rating and became an instructor in the C. A. A. flight training program for Rose. He has sort of a secret desire to become a pilot on one of the commercial airlines, but on the other hand he is pretty happy just to be working in the air. At one time he had hopes of joining the United States Air Corps but a physical exam checked that. He now claims that it is just as well because the other fellows that went up for the physical with him have either flunked or are dead.

Other than this hobby which he has turned into an occupation, he likes swimming and sports. He claims that whether or not one should study engineering depends entirely upon the individual; he says, however, that he would again study engineering, and at Rose. Philosophizing, Kenny claims that the prime requisite of a successful life is to be "greatly interested in your work,"—and he is.

Fly high, Kenny!

Departed

Lieutenant Clark N. Piper, pilot of the United States Army Air Corps and graduate of Paris high school and the United States Military academy at West Point, was killed March 12 when his single-seat Seversky pursuit plane crashed into a field five miles northeast of Dayton, Ohio. He had attended Rose for three years prior to entering West Point. Lieutenant Piper was on a test flight from the army aircraft laboratory at Wright Field.

In 1931 Lieutenant Piper, who was slated for a captain's commission this year, was one of 107 graduates of

Ken Buis, Cub Trainer, and Moritzy Fleming, senior.

the advanced flying school at Kelly Field, San Antonio, Texas. At various times he had been stationed at Pasadena, California; Selfridge Field, Detroit; and at Chanute Field, Rantoul, Illinois.

Lieutenant Piper is survived by the widow, Winifred; a son, William; his parents, and a brother, Dr. William Piper, army surgeon stationed at Carlisle, Pennsylvania. At Rose he was a member of the Sigma Nu fraternity. He returned to Rose for homecoming last autumn and again for the military ball just before Christmas.

Alumni—Be At Commencement

Now that the Rose Show is again history, the next mass envelopment of the school by the alumni will be commencement. For all the "events" of the week end see the February issue of the Alumni Quarterly and the next *Technic*—but the big thing to remember is BE AT COMMENCEMENT.

Rose Tech Clubs Meet

(Reprinted from the Rose Polytechnic Institute Bulletin, alumni quarterly issue, February, 1940).

A most enjoyable dinner meeting of the Philadelphia Rose Tech Club held at the Penn Athletic Club on December 7, was attended by seventeen alumni, an increase of more than one hundred percent over the previous party. Representatives of classes from 1905 to 1938 were present, and in addition to those from the City of Brotherly Love, delegates gathered from Trenton, Coatesville, Penns Grove, Chester, Camden, Wilmington, Toledo, and Madison, (the latter two were in town for the A. S. M. E. meeting).

Clarence L. Davison, '16, was elected President and Glen W. Ashley, '25, succeeded Davison as Secretary.

The following evening Rose alumni of the Pittsburgh region gathered at the University Club for the usual fall meeting. The customary roll call by odd and even classes, the members being seated on the left and right of the President, showed twenty-two present.

Did You Know That?

The entire surface of a normal lung is equivalent in area to 31 feet square. In 24 hours of normal respiration approximately 343 cubic feet is breathed.

After a brief business session and some stirring nominating addresses, an election of officers was held, as a result of which Guy V. Woody, '09, succeeded Brent Wiley, '98, as President, and Leon S. Maehling, '24, inherited the books of record from Edward J. Ducey, '11.

Dr. Prentice attended both meetings and his informal talks on affairs at Rose introduced reminiscences of the "good old days" and discussions of the present.

What They Are Doing

'25 Glen W. Ashley, formerly with the General Electric company, is in the engineering department of the Philco Corporation in Philadelphia.

Everett C. Gosnell visited the Institute March 9. At that time he informed the school that he is now chemical engineer for the Lukens Steel company of Coatesville, Pennsylvania.

'32 Robert D. Moench has taken a position with the Allison Engineering company of Indianapolis.

'36 James D. Hufford who is with the United States Gypsum company is now mill and packing superintendent of the plant at Fort Dodge, Iowa.

Chicago Alumni

The Chicago Rose Tech Club held its annual St. Patrick's dinner on March 14th at the Adventurer's Club, 14 N. Michigan Avenue.

Dr. John White and Professor Carl Wischmeyer were the guest speakers at the meeting, and the dinner was well attended, there being 53 members and one guest present besides the two guest speakers.

Oscar Baur was also present from Terre Haute, and he furnished the necessary refreshments.

The officers elected for next year were:

V. E. Schlossberg, '26, President; E. O. Austermiller, '17, Vice-President and Chairman Scholarship Committee; G. B. Henry, '18, Secretary-Treasurer.

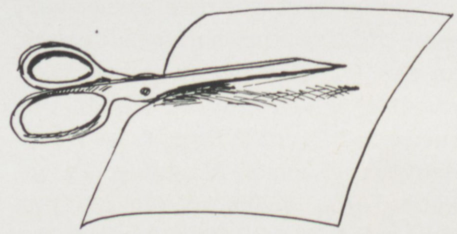
The names of the members who were present at the meeting are as follows:

Oscar Baur, '87; A. J. Hammond, '89; T. L. Condron, '90; Abe Balsley, '90; H. L. Wetherbee, '92; W. G. Arn, '97; T. G. Pierson, '97; A. G. Shaver, '97; F. W. Hahn, '04; W. S. MacNabb, '04; J. S. Jackson, '06; J. M. Johnson, '06; Carl Wischmeyer, '06; W. W. Kelly, '07; C. W. Post, '07; A. S. Hathaway, '08; C. N. Lammers, '08; A. B. Bareuther, '10; W. Webster, '10; R. C. Rehm, '12; J. T. Scott, '14; J. R. Wisely, '15; E. O. Austermiller, '17; F. G. Coates, '17; C. K. Failing, '18; G. B. Henry, '18; C. J. Dedert, '21; R. P. Failing, '22; K. E. Harmas, '22; D. R. Spencer, '22; E. S. Whitlock, '22; E. F. Donham, '23; H. C. Hocker, '24; A. L. Sherwood, '24; E. C. Gosnell, '24; G. P. Phillips, '25; C. L. Corbon, '26; V. E. Schlossberg, '26; B. G. Witty, '26; J. T. Harvey, '28; C. E. Sieglin, '28; F. O. Andrews, '29; H. P. Shewmaker, '29; R. E. Biller, '31; P. A. Smith, '32; R. V. Smith, '32; K. M. Miller, '33; G. L. Burt, '35; E. J. Cody, '35; C. C. Dierdorf, '35; N. E. Tucker, '35; A. F. Garzolini, '37; E. H. Eckerman, '38.

Cuttings

Once again the column goes to press, the cuts are not forthcoming, classes must be cut to get the copy in on time. *Cuttings* is again submitted for your approval (if the editor—the rat—does not cut the column out, as he almost did last issue.)

Back through dusty files of the *Technic* and out pops Volume XIX, number 7, April, 1910. It was "ah, glorious Spring," the time when a young man's fancy lightly turns to the various forms of pitching as



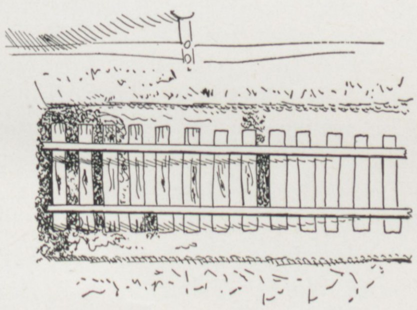
shown by this paragraph that appeared in the column called *Athletics*:

Coach Heze Clark has announced the following men who will constitute the baseball squad of 1910:

Shook, Captain and pitcher
Newlin, pitcher
Barret, third base and pitcher
Watts, utility infielder
Floyd, shortstop
Bradford, second base
Wyeth, center field
Buckner, left field
Hoffner, right field
Lawler, catcher
Fishback, utility outfielder

Track, as shown by the railroad engineer, is a pretty permanent thing, but around Rose it is something that comes and goes—good seasons, poor seasons, and no seasons. In 1910, however, there was a track team, as testified to by Coach Clark:

This year will mark a great revival of track athletics at Rose. Years ago no school in the state could defeat Rose Poly in track field meets. Then came the time when Rose was no longer strong in this line and Purdue took the lead. . . . This year the Rose team will again be a factor in the I. C. A. L. meet. There are a number of men



Track at Rose

who, if they train as they should, are sure to make points in the great I. C. A. L. meet which is to be held for the first time in history on the Poly campus.

There is more for the Rose Poly track men to work for this year than ever before. A meet will be scheduled with Indiana State Normal to be held on the Rose Poly campus some time in April. What man at Rose but would give almost his hopes of heaven just to have the pleasure of defeating Normal? How the Rose men love to defeat the teachers! . . .

A partial list of the track men at

Rose follows: Bradford, Shaw, Coffey, Cooke, Spindle, Heer, Rasmussen, Standau, Webster, and Kelley. This surely ought to be a big year in track for the engineers, and should be long remembered as the season that marked the revival of track teams at Rose, and the building of the new track.

—well, we didn't win the I. C. A. L., *but we beat the tar out of Normal!*

In a desire for less dust on the copy we acquired the April, 1934, issue (volume XLIII, number 7). Dan Overholser, ch. e., '36, editor of *Campus Activities* printed this choice item:

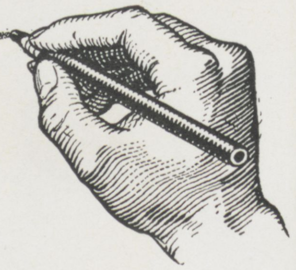
Crash

Crash! What was that? That is what students were wondering on the morning of March 13 as they sat in classes on the upper hall. Could the bookcase have fallen over in the office?

No, it was not that. Brent Jacob, who had been cruising about in the attic, had made a misstep and had

(*Please turn to page* 31)

Fraternity Notes



Lambda Chi Alpha

On February 28, the Alumni club of Terre Haute gave a dinner at the Roma cafe in honor of this year's pledge class. The dinner was attended by pledge brothers Norman J. Pera, J. Robert Norris, H. Errol Porter, Frank Jones, James S. March, William V. Beatty, Warren R. Rombough, William C. Soudriette, and James F. Armacost. Active members present were Thomas Lane and Robert Ringo. The Alumni club was represented by Dudley Balsley, Ben Smith, Orvil Johnson, Clarence Reid, Walter Osmer, and Wayne Watson, Bruce McIntosh, the executive secretary of Lambda Chi Alpha, also attended.

The entertainment of the evening was furnished in the form of impromptu speeches by the pledges. Each related the experience in his life which he thought would be the most amusing to the group.

It was decided at this meeting that a joint dinner meeting of the Alumni club and active chapter would be held once a month.

Theta Xi

Kappa chapter of Theta Xi held its annual pledge dance on March 1, at the Deming ballroom of Hotel Deming. Jimmy Maxwell's orchestra played for the dancers from 9 till 1 o'clock. Chaperons for the evening were Miss Mary Gilbert, Mr. and Mrs. E. A. MacLean, and Dr. and Mrs. O. S. Knight.

On Sunday afternoon, February 25, at 2 o'clock, iniation services were held for Ralph L. Elmendorf, of Evansville, Indiana. Ralph is a sophomore in the chemical engineering department.

The following new committees were appointed for the semester: Furniture, Ray Hogan, chairman; Dave Demaree, and John Bolton; Social, Fred Wehle, Chairman; Walter Zehnder, and Fred Nahm; Initiation, Nick Smilanic, Chairman; Jack Vander Veer, and John Taylor. Plans are being made for the spring formal dance to be held on May 17th.

Alpha Tau Omega

At the chapter meeting of March 25, the officers were elected for the coming year. Worthy Master Stanley Craig then installed Charles A. Howlett, of Terre Haute, as the succeeding W. M. The other officers to be elected were: Joseph W. Dreher, of Terre Haute, Worthy Chaplain; Robert D. Phelps, of Paris, Illinois, Worthy Keeper of the Exchequer; John L. Combs, of Indianapolis, Worthy Scribe; John R. Roberts, of Indianapolis, Worthy Keeper of the Annals; John G. Appel, of Terre Haute, Worthy Usher; John E. Bartmess, of Lima, Ohio, Worthy Sentinel; John G. Mehagen, of Riverside, Illinois, *Palm* Reporter, and Frank M. Beeler, of San Diego, California, Social Chairman.

CUTTINGS

(*Continued from Page 29*)

fallen partially through the metal-plated ceiling.

Sam Tait, who was walking through the hall, heard the crash and looked up to see a pair of legs dangling through a hole in the ceiling. Although Brent was not hurt, he seems to have no desire to attempt any more acrobatic stunts.

—And so, my dear alumni, this ends *cuttings* for this month. A new staff takes over the next issue. Just who those men will be, no one knows as yet. To look back over the year and the column—and that seems to be the way to close the last issue—I hope that you have liked your page, and I hope you also have liked the alumni editor's brain child, *Cuttings.* I want to thank all of you for sending your news to the school and the *Technic,* and, if a new years greeting is not out of the way, I want to *wish you each the best of everything.* —*The Alumni Editor*

CORROSION

etched by Harold E. Bowsher, c., '42

CLANK VERSE

Ruth rode in my new overdrive
On the seat in back of me,
I hit a bump at fifty-five
And rode on ruthlessly.

SOME DATE

Gloria: "I had a date with a general last night."

Betty: "Major general?"

Gloria: "Not yet."

The Technograph

YOU MAY GET IT TO

"Hey!" said Satan to the new arrival, "you act as if you owned the place."

N. W.: "I do. My wife gave it to me."

ENGINEERS AREN'T THAT WAY

Once there was an innocent little school girl who wouldn't study fractions because some of them were improper.

Exchange

YOUR CHOICE

Prison Warden: "I've had charge of this prison for ten years. We're going to celebrate. What kind of a party do you boys suggest?"

Prisoner: "Open House!"

OVERHEARD IN CALCULUS CLASS

Soph 1: "What's Doc talking about?"

Soph 2: "Integration, you dimwit."

Soph 1: "Well, is he for it or against it?"

THE ENGINEERS LAMENT

Listen collegians and you shall hear
The sad, sad tale of an engineer.
All the day long he meets in his classes,
The male of the species, no beautiful lasses.
No astonishing babes frolickin' with 'em,
Just sliding the rule of the logarithem.
The electrical man may love a new circuit,
But the problem of women! They'll never work it.
The theory of mechanics is mastered by many.
The masters of women! Gosh, there ain't any.
The civils are always blazing new trails,
But they're not so hot at praising the frails.
A bunch of the boys are studying the mines,
And they find no faults with the female designs.
The rest of the gang is messing with chemicals
Which leaves little time for testing the femmy-gals.
'Tis a bleak, dismal outlook to the engineer,
To go through school without feminine cheer.
Can nothing be done about this deplorable state?
Ah me, no! 'Tis the engineer's fate.

DAMMIT

AUDUBON NOTE

Protect the birds. The dove brings peace and the stork brings tax exemptions.

TIMBER!

Reporter: "I've got a perfect news story."

Editor: "How come? Man bite dog?"

Reporter: "No, but a hydrant sprinkled one."

BEWARE

It's all right to tell a girl she has pretty ankles but don't compliment her too highly.

FROM THE MAIL BAG

Dear Don:

I just read in the paper that students who don't smoke make better grades than those who do.

Dad

Dear Dad:

I have thought about it, but truthfully I would rather make a "B" and have the enjoyment of smoking; in fact, I would rather smoke and drink and make a "C". Moreover, I would rather smoke and drink and neck and make a "D."

Don

Dear Don:

I'll break your neck if you flunk anything.

Dad

Latest definition for a baby carriage: Blunder-bus.

'37 MODULUS

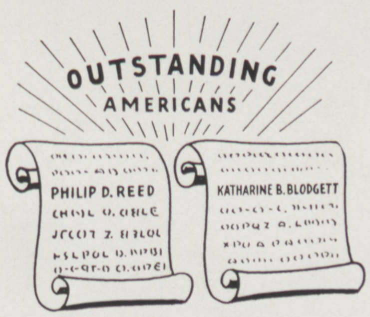
Ken Mc—, who graduated last year, landed a soft job—he's in a bloomer factory now pulling down about two thousand a year.

G-E Campus News

4400 TIMES HIS OWN WEIGHT

A MAN could lift four 100-ton freight cars if he were proportionately as strong as a new Alnico magnet assembly recently developed in the General Electric Research Laboratory.

The greatly increased strength of the new magnet is due to a special mounting, which permits the magnetic flux to pass through many air gaps instead of the usual two in bridging from pole to pole. This makes possible a more efficient utilization of the magnetic energy. In recent laboratory tests a magnet weighing only one quarter of an ounce was able to support 69 pounds—about 4400 times its own weight. This new development, although not yet commercially available, broadens the field of permanent magnet applications.



TWO OUT OF TWENTY

IN his selection of the 20 outstanding men and women of 1939, Durward Howes, editor of "America's Young Men," honored two General Electric leaders: Philip D. Reed and Katharine B. Blodgett.

Mr. Reed has been with General Electric since 1926. He received his engineering degree from Wisconsin in 1921 and his law degree from Fordham University three years later. In 1937 he became the assistant of Gerard Swope, President of General Electric. Mr. Reed is now Chairman of the Board of Directors.

Miss Blodgett was graduated from Bryn Mawr in 1917, received her M.S. degree from the University of Chicago, and spent the next six years in the General Electric Research Laboratory in Schenectady. In 1924 and 1925 Dr. Blodgett studied at the Cavendish Laboratory in Cambridge, England, where she received the degree of Doctor of Philosophy. Returning to the G-E Research Laboratory, she has since been engaged in the study of molecular films.

2,000,000 HORSES

EVEN in its heyday the Wild West would hardly have tried stopping a stampede of 2,000,000 horses. Yet the job of stopping 2,000,000 horsepower of electric energy has been assigned to the General Electric breakers installed at Boulder Dam, and they do the job in 1/20 of a second. And the relays which trip these breakers are even more versatile, for it takes them only 1/200 of a second to locate trouble and trip the proper breaker.

The power developed at Boulder Dam is carried to Los Angeles at 287,000 volts—the highest voltage in the world in regular service. Two transmission lines, running side by side, are used to span the 380 miles. To protect these lines required the development of circuit breakers capable of interrupting one and a half million kilowatts of power.

Student engineers, recent college graduates taking the G-E Test Course, had the responsibility of testing these circuit breakers in the Philadelphia Works of General Electric.

GENERAL ELECTRIC

953-1C


FRANCESCA SIMS
of TEXAS
Chesterfield Girl of the Month
A roundup of all you
want in a cigarette
CHESTERFIELD
they're COOLER
they TASTE BETTER
they're DEFINITELY MILDER
Chesterfield
CIGARETTES
LIGGETT & MYERS TOBACCO CO.
CHESTERFIELD
These are the things you get from Chesterfield's right combination of the world's best cigarette tobaccos.
Make sure of more smoking pleasure . . . make your next pack Chesterfield and you'll say "They give me just what I want . . . THEY SATISFY."
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